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SCIENCE 7

Module 1 Interactions and Ecosystems

Learning Technologies Branch

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SCIENCE 7

Module 1

Interactions and Ecosystems

Learning Technologies Branch

Alberta LEARNING

Science 7
Module 1: Interactions and Ecosystems
Student Module Booklet
Learning Technologies Branch
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The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Student Module Booklet.

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

You may find the following Internet sites useful:

- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
- Learning Resources Centre, **http://www.lrc.learning.gov.ab.ca**

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Module 2 Plants for Food and Fibre

Module 3 Heat and Temperature

Module 4 Structures and Forces

Module 5 Planet Earth

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Resources

Textbook

To complete the course, you need the textbook *ScienceFocus 7*.

Multimedia

Attached to Module 1 of this course is a CD titled *Science 7 Multimedia*. This CD contains multimedia segments designed to help you better understand particular concepts presented in this course. Ask your teacher or home instructor if you need help using this CD.

Materials and Apparatus

A list of materials and apparatus is given on page 10 of each Student Module Booklet. These items are needed to complete the module. Some of the materials and apparatus may be provided at your local school lab. If you don't have access to a school lab, you will need to get the loan kit. Talk to your teacher for more information.

Before You Begin

Organize your materials and work area before you begin: Student Module Booklet, textbook, notebook, pens, pencils, and so on. Make sure you have a quiet area in which to work, away from distractions.

Because response lines are not provided in the Student Module Booklet, you'll need a looseleaf binder or notebook to respond to questions and complete charts. It's important to keep your lined paper handy as you work through the material and to keep your responses together in a notebook or binder for review purposes later.

Refer to the Planning Ahead page for directions on what you need to do before you start this module.

Icons

This is one of five Student Module Booklets for Science 7. As you progress through this module, you will meet several icons.

Do Ahead

Some preparation must be started well ahead of the activity or investigation. For example, start the seedlings for the investigation in Lesson 3.

Teacher or Home Instructor

The teacher or home instructor should be contacted for help, approval of some procedure, or checking answers.

Assignment Booklet

Work needs to be done in one of the Assignment Booklets.

Safety

You must be very careful when you see this symbol.

Textbook

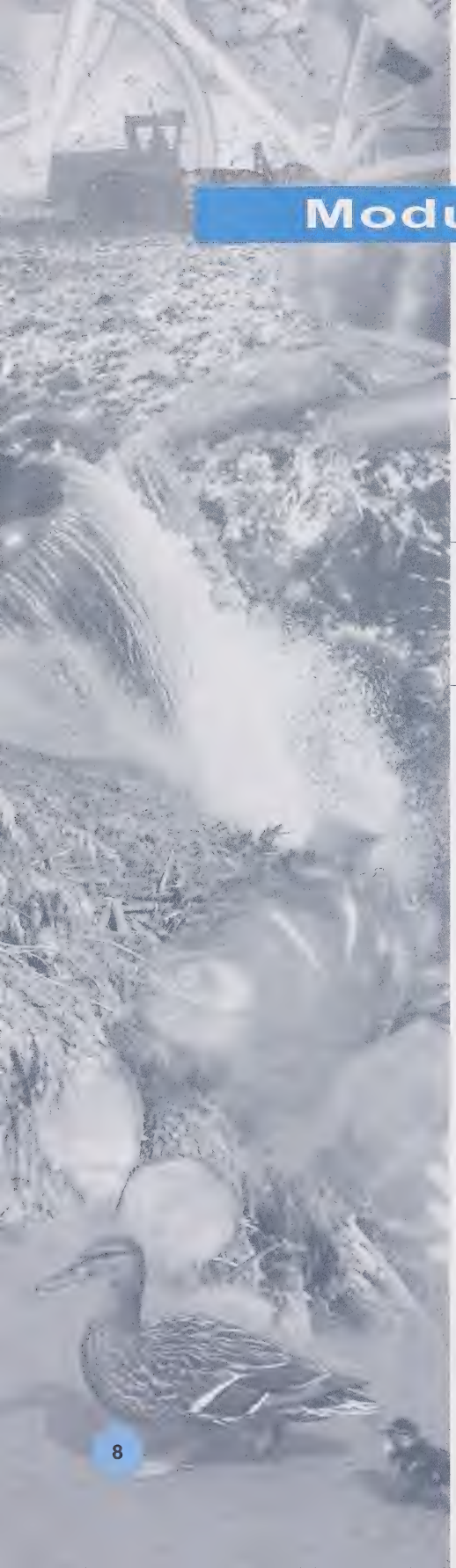
A reference is made to *ScienceFocus 7*, the textbook accompanying this course.

Internet

This is a reference to the Internet. **Note:** Any Internet website given is subject to change.

Multimedia

This is a reference to the *Science 7 Multimedia* CD.



Overview

Module 1 Interactions and Ecosystems

Section 1
Living Things and Their Surroundings

Section 2
The Flow of Energy and Matter

Section 3
Watching Changes in Ecosystems

Have you ever spent time in one of Canada's national parks? At Banff or Jasper National Parks, you can see the beauty of forests, lakes, and mountains. All have been undisturbed by human activity. You can see wildlife—elk, bears, and bighorn sheep—not usually seen outside these parks.

Living things, their setting, and their contacts form an ecosystem. The national parks of Canada are ecosystems. The rules for these parks come from the Canada National Parks Act. It makes keeping ecological integrity its number one priority. (The most important thing is the protection of nature as it is.) This means Alberta's natural beauty is safe for the future.

National parks are special ecosystems. Other ecosystems have been ravaged by human activity. In this module, you will study ecosystems. You will learn about their parts and interactions. You will identify natural cycles and processes of change. Environmental monitoring and research will let you see the costs of human activity. You will also see that what you expect to happen often comes with unexpected results. This awareness shows the need for careful decision making.

Protecting the environment requires thought and work. Read pages 2 to 5 of the textbook for more about what is ahead in Module 1.

Assessment

This booklet is the Student Module Booklet. It will show you, step by step, how to advance through Module 1: Interactions and Ecosystems.

This module, Interactions and Ecosystems, has three sections. Each section is built of lessons. Within the lessons, there are readings, investigations, activities, and questions for you to do. By completing these lessons, you will

- discover scientific concepts and skills
- develop a positive attitude toward science
- practise or apply these new concepts and skills

There are suggested answers in the Appendix of this Student Module Booklet. They provide you with a way to check your understanding. Your teacher will also provide you with feedback on your progress throughout the module.

At several points in this module, you will be directed to the accompanying Assignment Booklets. Your grading in this module is based on the assignments you submit for assessment. In this module you are expected to complete three section assignments and a final module assignment.

The mark distribution is as follows:

Assignment Booklet 1A	
Section 1 Assignment	40 marks
Assignment Booklet 1B	
Section 2 Assignment	56 marks
Assignment Booklet 1C	
Section 3 Assignment	35 marks
Final Module Assignment	53 marks
TOTAL	184 marks

Planning Ahead

Here is a list of materials and apparatus you will need to complete this module.

Section 1

- ❑ toothpicks
- ❑ kitchen tongs
- ❑ clothespins
- ❑ spoons
- ❑ small plastic bags
- ❑ clock (or watch)
- ❑ rice
- ❑ cereal in the shape of rings
- ❑ elastic bands
- ❑ raisins
- ❑ 2 rectangular aluminum foil baking pans
- ❑ scissors
- ❑ modelling clay
- ❑ bucket
- ❑ 500-mL beaker or large glass
- ❑ graduated cylinder
- ❑ 3–5 small sponges
- ❑ food colouring

Section 2

- ❑ samples of rainwater
- ❑ samples of water from a water system
- ❑ sample of tap water
- ❑ pH indicator paper
- ❑ 2 Erlenmeyer flasks (or jars with tight lids)
- ❑ 2 small, clear cups (or similar containers)
- ❑ modelling clay
- ❑ flexible drinking straws
- ❑ small, live aquarium snails
- ❑ bromthymol blue indicator

Section 3

- ❑ 2-L, clear, plastic bottle
- ❑ potting soil
- ❑ a small aquatic plant (maybe from a pet store)
- ❑ wild birdseed
- ❑ field guide to amphibians
- ❑ map of Alberta
- ❑ 4 metre-sticks or 4 wooden pegs per group
- ❑ several jars with caps
- ❑ magnifying glass
- ❑ clipboard
- ❑ field guides
- ❑ duct tape
- ❑ string

In Section 1: Lesson 3, you will need to keep track of what you are throwing away for one week.

If you have access to the Internet, you may want to check out some of the links for this module ahead of time. Go to the following site:

http://www.mcgrawhill.ca/school/booksites/sciencefocus+7/student+resources/toc/index.php

Section 1

Living Things and Their Surroundings

Imagine campers tenting beside a pond or a river. A beaver suddenly pops out of the water. If the campers stay very quiet, they might see the beaver go about its busy work. If they make the slightest noise, the beaver will dive out of sight. This one-time interaction between the beaver and campers is harmless. However, if this happened many times, it could seriously disrupt the beaver's lifestyle. The beaver would likely be scared away to another area.

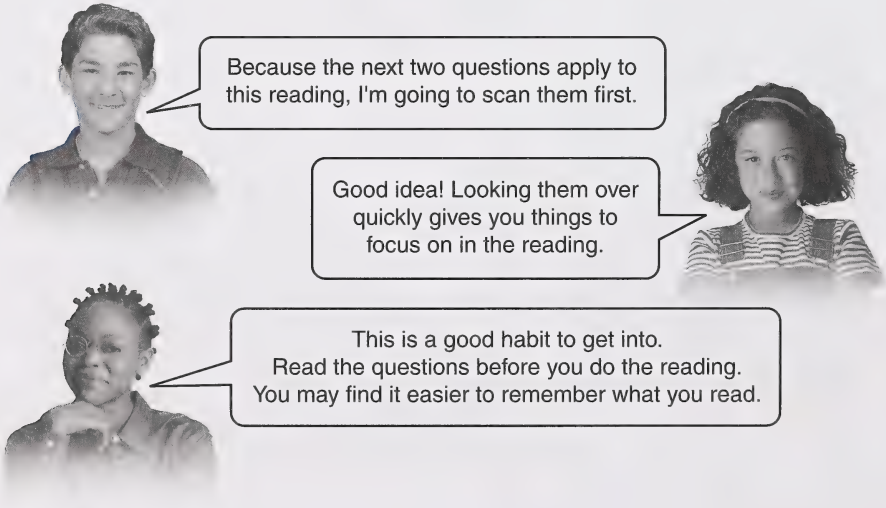
Would the beaver's departure really matter? Could anything be done to minimize the campers' impact on the environment? Could the beaver have a significant impact on the campers?

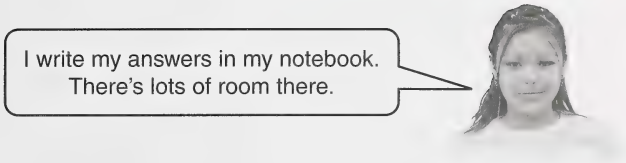
In this section you will identify how living and non-living parts of an ecosystem interact. You will gain an awareness of the needs of living things. You will look at the adaptations that help them meet their needs. You will also study changes on the environment due to human impact and identify ways you can contribute to protecting the environment.

Lesson 1: Interactions Within Ecosystems

Imagine that someone moved into your home. They used all of your family's possessions at will. They changed your home as they saw fit. They left little or nothing for you and your family. In a sense, this happens a lot all over Earth. Humans move in, change, and dominate the homes of other species. This decreases the quality of the original species' lives and forces them out. Sometimes, it causes them to become extinct. The tiny swift fox, for example, has been severely affected by human activities.

Turn to pages 6 and 7 of the textbook. Read the introductory paragraphs of "Topic 1: Interactions Within an Ecosystem." It gives a description of the factors that caused the swift fox to be wiped out in Alberta.


Because the next two questions apply to this reading, I'm going to scan them first.
Good idea! Looking them over quickly gives you things to focus on in the reading.
This is a good habit to get into. Read the questions before you do the reading. You may find it easier to remember what you read.



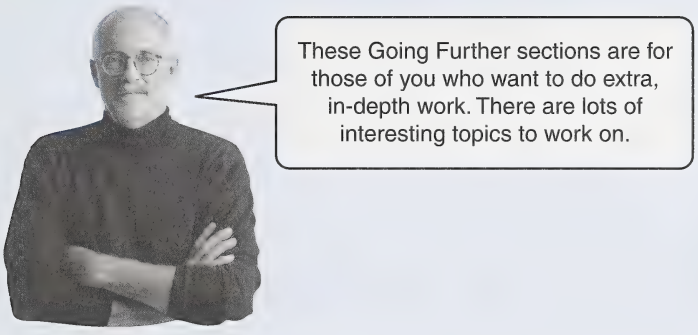
1. Define the terms *ecology* and *ecologist*.

2. What two major human activities caused the total loss of swift foxes from Alberta?

3. Do "Pause and Reflect" on page 7 of the textbook.

Compare your responses with those in the Appendix, page 94.

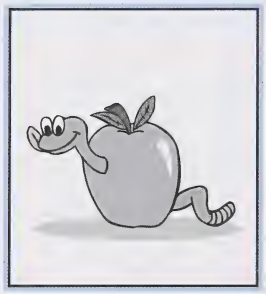
Going Further


These Going Further sections are for those of you who want to do extra, in-depth work. There are lots of interesting topics to work on.

Garbage can pollute the ecosystem. Is recycling really reducing garbage? Investigate this issue for yourself. Read and follow "Looking Ahead" on page 5 of the textbook.

The swift fox is an adorable carnivore with an interesting history. To find out more about the swift fox, do "Internet Connect" on page 7 of the textbook. By doing this activity, you will get an early look at a food web. Food webs will be introduced in Section 2: Lesson 1 of this module.

The Needs of Living Things



Turn to page 8 of the textbook and read "The Needs of Living Things."

4. Copy and complete the following table. (Put it in your notebook.) The first need is done for you.

Basic Needs of All Living Things	
Basic Need	**Reason(s) Why It Is Necessary to All Living Things**
food	**Food gives living things energy. It also provides nutrients required for growth and reproduction.**

Check your responses with your teacher or home instructor.

5. Identify which basic need is being met or not being met.

   a. A beaver rushes to the surface after working on the bottom of a pond for several minutes.

   b. Your favourite houseplant withers and dies while you are away on vacation.

   c. A coyote digs a den on a hillside.

   d. A mosquito sucks blood from your arm.

Compare your responses with those in the Appendix, page 94.

Being able to meet special needs is the deciding factor in where a species lives within an area. Besides food and water, shelter from weather and predators may be important. These important needs must be "within reach." (A snail must have them much closer than a deer or bird.) If there is another species with similar needs, competition may force one of the species out. Such factors affect the distribution of a species in a given area.

Going Further

Is there anything alive out there? Find something where you live, like a bird or a spider. Then observe and investigate it. Follow the directions in "Find Out Activity: Just the Basics" on page 9 of the textbook.

Do you want to know more about "making a living" in the wild? If you enjoy using a computer, "Computer Connect" on page 9 of the textbook may be right down your alley!

Adaptations

Have you ever left your home in a rush on a cold morning without putting a coat on? Were you called back with "Put on your coat. You don't want to catch a cold"?

It is good advice to put on a proper coat in cold weather. Without a coat, your body temperature could drop dangerously low. You might suffer from hypothermia or frostbite. Humans are not physically **adapted** to a cold environment. The people in the picture here reside in Canada's north. Because of the severe climate, a warm coat is needed to stay alive.

adapted: well-suited

A polar bear, on the other hand, is physically adapted to the climate in Canada's north. Its body includes a protective coat of hair and an insulating layer of fat. These protect it from the harsh, cold weather.

Turn to pages 10 and 11 of the textbook and read "Adaptations." Note the specific examples of how species have adapted to their environment.

6. Define *adaptation*.

Compare your response to the one in the Appendix, page 94.

When adaptations affect the body of an organism, they are called **structural adaptations**. A particular structural adaptation often relates to the lifestyle or environment of an organism. The bat's wings, ears, and radar system are structural adaptations. They allow it to locate and catch the insects it eats.

Adaptations that relate to the way an organism acts are called **behavioural adaptations**. Mice usually try to remain under or near cover. This behaviour decreases the chance of being caught by a predator.

7. Drought has made food hard to find. A bear learns how to open "bear-proof" garbage cans. This new talent allows the bear to feed herself and her two cubs. Is this behaviour an adaptation? Explain.

Compare your response to the one in the Appendix, page 94.

8. Based on your understanding of structural and behavioural adaptations, draw or build a weird and imaginary creature with adaptations for the following:

    - lives in pools of volcanic lava, where the air above the pools contains poisonous gases
    - moves very quickly to catch prey as they pass the lava pools
    - obtains all its food and water from its prey, but is not strong enough to tear the body of the prey apart
    - catches its prey with its ears
    - any other adaptation you think might be fun or important to your creature

    You must be able to explain each adaptation, its classification and function (purpose), to your teacher or home instructor. Make sure your creature will be able to meet each of the four basic needs you studied. Have fun creating!

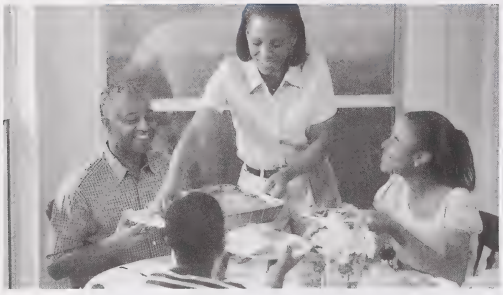
Show and discuss your creature with your teacher or home instructor.

Going Further

It's time to get physical! Try "Investigation 1-A: Tools for the Task" on page 12 of the textbook. Experience the need for specialized equipment to do specialized jobs. You can use each tool yourself for 30 seconds or involve your family, friends, or home instructor in a competition. Have fun!

It is amazing the way some organisms obtain food! Research some of the weird, wacky, and wild ways. Refer to "Internet Connect" on page 10 of the textbook to get yourself started.

What Is an Ecosystem?



Sitting down to a meal with the rest of your family is a time you can enjoy. There's not only the food, but also the conversation. One person says something, and another person responds. You respond to that, and others respond to what you say. This interaction continues and is what makes mealtime so special.

This is only part of the interaction you are involved in. In your home, yard, and community, you interact with family, friends, pets, and plants. You constantly affect and are affected by the non-living things around you (wind, TV, the amount of light and heat in your room). You could think of your home, yard, and community as your own personal **ecosystem**. All the interacting parts, both living and non-living, create your specific ecosystem.

Similarly, there are natural ecosystems. Wind, temperature, and precipitation affect water levels. Water availability affects the reproductive success of ducks. Duck populations affect the food supply of coyotes. Prey selection of coyotes affects the population of ground squirrels. The number of ground squirrels affects the aeration and water content of the soil. For each of these living and non-living things, there is a unique web of interactions. Even at their simplest, the web of interactions in a natural ecosystem is very complex. **Populations** of different organisms living in the same area together form an interacting **community**.

The space taken up by an ecosystem does not need to be large. It can be as small as a log. Turn to page 13 of the textbook and read "Ecosystems."

9. Write a definition for the terms *ecosystem*, *population*, and *community*.

Check your response with your teacher or home instructor.

Symbiosis

Do you have a dog? If not, would you like to have one? If your family decided to get a dog, they would probably think twice before getting the dog near this sign. The sign suggests some nasty little parasites are riding on the dog. A flea market is actually a place where you can get second-hand items, like furniture and knick-knacks.

Ecosystems are made up of many interactions. Many of the interactions are ongoing between different species. They are not necessarily ongoing between individuals of the species. For example, the same mosquito may bite you one day and your friend the next day. The species are interacting, only the individuals have changed. There is, however, a special class of interactions in which partners get real close and personal and stay close for quite a while. For example, a dog and a flea (or fleas) form such a partnership. This partnership is close, but it's not as if the dog had much choice in the matter.

Long-term relationships between organisms of different species are called symbiotic relationships or **symbiosis**. There are many different types of symbiosis—not all are good relationships.

Turn to pages 14 and 15 of the textbook and read "Interactions in Ecosystems." You will get more information about symbiosis.

10. Write a definition for the terms *mutualism*, *parasitism*, and *commensalism*.

11. Copy the following table into your notebook. Identify and describe the type of symbiosis in each example. The first one is done for you.

Identifying and Describing Symbiotic Relationships

Organisms Involved	Description of Relationship	Type of Symbiotic Relationship
remora and sharks	**Remora eat bacteria and micro-organisms unhealthy for sharks.**	**mutualism**
ants and aphids		
tapeworms and people		
orchids and tree trunks		

12. One student represented the three types of symbiotic relationships with symbols. They used + + (plus plus), + – (plus minus), and + 0 (plus zero). Which symbol should be used for each relationship in the table? Explain your choices.

Check your responses with your teacher or home instructor.

Impacts on Ecosystems

Symbiotic relationships demonstrate that one organism can have an impact on another. One organism can even have a significant impact on a whole ecosystem. The beaver is an obvious example. It greatly alters an area when it cuts down trees and builds a dam, flooding an area. The amount of light, temperature, soil, water availability, and shelter change. Organisms that are better adapted to the new conditions replace some of the old plants and animals. In the flooded area, land organisms are forced to leave (or die) and water organisms find a new home. Water held behind a dam has more time to soak into the ground and dissolve substances from the soil. Effects continue downstream due to the change in water flow and composition.

Turn to page 16 of the textbook and read "Impacts on Ecosystems."

13. Answer "Pause and Reflect" on page 16. **Remember:** The study animal is from "Pause and Reflect" on page 7 of the textbook.

Compare your response with the one in the Appendix, page 95.

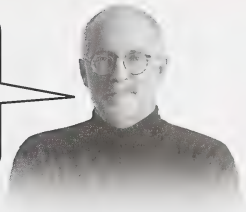
DID YOU KNOW?

The Great Barrier Reef is the largest surface structure ever built by any living thing. At 1900 km long and up to 160 km wide, it can easily be seen from space. This immense structure forms an ecosystem. It was built by the combined activities of countless microscopic organisms over thousands of years. If each of these tiny individuals could make their mark, isn't it likely you could too?

Going Further

Poetry and science, could they possibly relate to each other? You bet! One such example is explored in "Find Out Activity: Chain of Events" on page 17 of the textbook. Look at the chains of events that create an ecosystem in a different and poetic way.

You have now completed the new concepts for this lesson. Now you get a chance to work with them. Complete the following questions. They will let you see how well you are doing with these new concepts.



14. Answer questions 1, 2, and 4 of "Topic 1 Review" on page 17 of the textbook.

Compare your responses with those in the Appendix, page 95.

Looking Back

Impacts, adaptations, interactions, and ecosystems—do any of these relate to you? You are probably beginning to see that they do. A significant change in some aspect of an ecosystem impacts another part, which impacts another, and so on. Organisms and species negatively affected by these interactions must adapt, move, or die. You and other people can appear in any position along the chain of interactions. Your actions can contribute positively or negatively to the health and well-being of local ecosystems and the global environment.

Turn to pages 1 and 2 of Assignment Booklet 1A and answer questions 1, 2, and 3.

Lesson 2: Human Impacts on Ecosystems

The field on the left was once forested. Close your eyes for a moment. Can you imagine what this area might have looked like last year? 5 years ago? 50 years ago?

Although this field had remained forested for hundreds of years, it all changed in one year. The trees on this field were harvested for a human need—the need for wood. The wood was needed for building new homes.

Generally, as human needs for material things are met, there is an impact on the environment. Unfortunately, these effects can be negative and even irreversible. As you move through this lesson, you will look at how human needs and wants impact ecosystems. You will use this knowledge to think about ways you and society can minimize these impacts.

Human Impacts—A Growing Concern

Imagine having to cut down trees with only an axe. You would not have much of an impact on a forest in just one day. Suppose you were able to operate a logging machine. Your impact would be of much greater concern, don't you think? This comparison illustrates why technological advances play a big role in the increasing human impact on the environment.

The world you live in is very different from the world a century ago! Advanced forestry and agricultural technology, planes, high-rise buildings, highways, electricity, and telephones are just a few examples of recent human advancements. Our relationship with nature has changed a great deal since the early settlers came to Western Canada.

It's now time to learn how human impact on the local and global environment has changed over time. Turn to pages 18 and 19 of the textbook. Read the introductory paragraphs of "Topic 2: Human Impacts on Ecosystems." Then read "People and Nature—A Changing Relationship" and "Gathering Food in Alberta: Then and Now" on pages 20 and 21.

1. Answer question 6 of "Topic 2 Review" on page 28 of the textbook.

2. Both humans and beavers build dams. Compare the size of impact these dams have on the environment.

Answering with lists, tables, labelled diagrams, and in point form can help you communicate clearly.

Compare your responses with those in the Appendix, page 96.

Is That a Need or a Want?

You **need** shoes and a winter coat. You **want** a portable mp3 player or a silver bracelet. There are many other things that are hard to classify as either a need or a want. For example, the blouse that catches your eye—is it a need or a want?

Generally, it's hard to distinguish between wants and needs. Yet, just being conscious of things you don't need will help you spend your money more wisely—and conserve some natural resources as well.

Imagine a special occasion. You have just received a letter from an aunt with a cheque for you for $150. Your aunt wants you to spend this money on some items you **need** as well as some things you **want**.

3. Separate **needs** and **wants**.

   a. List the items you would like to purchase. Identify which items are needs and which items are wants.

   b. Create your own definition for the terms *need* and *want*.

Check your responses with your teacher or home instructor.

Did you find it easy to separate your needs from your wants? Do you think needs are the same for all people? Do you think wants are the same for all people? Should excessive human wants override the needs of other organisms? These are questions the next reading deals with.

Turn to pages 22 and 23 of the textbook and read "When Is a Need a Want?"

4. Are needs and wants the same for all people?

5. Human wants often conflict with the needs of animals. Provide at least two examples of this from the textbook.

Compare your responses with those in the Appendix, pages 96 and 97.

Going Further

Be a survivor! Knowledge gained now could make a difference in your future. Do "Find Out Activity: Alberta Grown" on page 22 of the textbook today.

Canada's First Nations had to meet their needs directly from their environment. Find out more about how they used the natural world to provide for their needs. Try "Internet Connect" on page 22 of the textbook.

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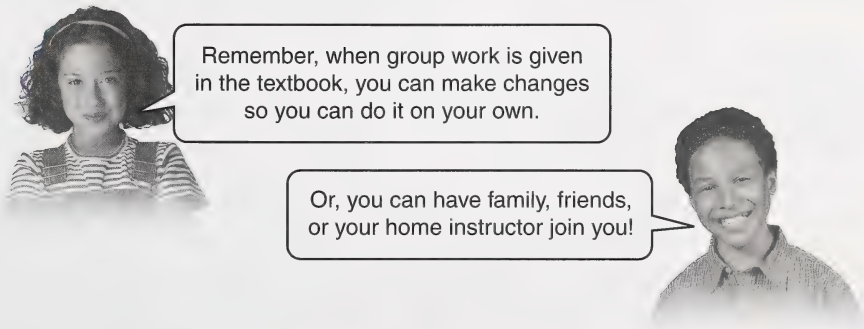
Developing Skills—Graphic Organizers

"A picture is worth a thousand words." A graphic organizer can show information visually, making it a valuable format. A graphic organizer, for example, can help you with these science skills:

- information
- organization
- communication

Read about graphic organizers in "Skill Focus 2" on pages 447 and 448 of the textbook.

6. Do questions 1 to 5 of "Instant Practice" on page 448 of the textbook. Plan your work so it is neat and appropriately sized.


Remember, when group work is given in the textbook, you can make changes so you can do it on your own.
Or, you can have family, friends, or your home instructor join you!

Check your responses with your teacher or home instructor.

Learning from Past Mistakes

You can recognize some of the impacts that humans have on the ecosystems around them. You are able to understand and identify the conflict between what humans want and what wildlife needs to survive. Fortunately, there are many people working to increase their knowledge about ecological interactions. Based on this knowledge, wise choices can be made. For example, wind turbines now generate some electrical power. There are fewer pollutants than from coal-fired generating stations.

Turn to pages 24 and 25 of the textbook and read "No Simple Answers."

7. DDT was used as an insecticide. What was one of the unpredicted consequences of the use of DDT in the mid-1900s?

8. Why is a healthy predator population important to the health of their prey species?

Check your responses with your teacher or home instructor.

Going Further

A species saved from the brink of extinction is a successful result of scientific monitoring and research. Visit the website given in "Internet Connect" on page 25 of the textbook. View some of the peregrine falcon work being done by scientists in Canada.

The Value of Wetlands

The human need (or want) for more roads and new housing has had a major impact on wetlands in Alberta. Filling these areas has affected the plants and animals in the area. It has also changed the movement of water in the local and global environment. The next activity will give you a chance to discover the value of wetlands. You will get to predict what can happen if a wetland area is destroyed or damaged.

Investigation 1-B Wetland Wonders

Refer to the investigation on pages 26 and 27 of the textbook. Read "Think About It" and "How Can Science Help?"

Copy the table that appears in step 3 into your notebook. Then carefully read and follow the steps in the Procedure.

9. Answer questions 1 to 4 of "Analyze" on page 27 of the textbook.

Compare your responses with those in the Appendix, page 97.

end of investigation

There are many people who choose careers as ecologists and biologists so they can study organisms, the environment, and/or the impacts humans have on ecosystems.

Read "Career Connect" on page 28 of the textbook to find out some of the things these jobs could include.

Going Further

Ducks Unlimited is an organization working to preserve wetland habitats in Canada. Find out more about this organization and the work they are doing where you live. Use the local library, the Internet, or any other means to do your research. Then answer the research questions in "Career Connect" on page 28 of the textbook.

Ducks Unlimited Canada
CANADA'S CONSERVATION COMPANY

10. Answer questions 1 to 5 of "Topic 2 Review" on page 28 of the textbook.

Check your responses with your teacher or home instructor.

Looking Back

Picture yourself as one of the organisms that used to live here. What would your situation be right now? Our relationship with the world around us has changed over time. Wants and needs have become more extensive and more complex. Human demands and actions seriously conflict with the needs of wildlife. They may create even greater problems in the future—unless humans make wise choices.

Scientific research and monitoring allow people to make wise choices. Some of the ecosystem damage can be reversed and current and future impact on the environment can be reduced.

Turn to page 2 of Assignment Booklet 1A and answer question 4.

Lesson 3: Environmental Choices

You go into a convenience store on a hot day to buy a cold drink. Besides the different pops available, there are many choices of containers—aluminum, glass, plastic, or tetrapak; large or small; recyclable or disposable. Which container do you choose? Is it just a matter of getting the best deal for your money? Or do you think about natural resources and the environmental cost of making and disposing of the container?

Are you **responsible** for natural resources and the environment? Besides, will your final choice really affect you or your environment in the end? The answer is yes! Each time you make a wise environmental choice, you minimize the demand on Earth's resources. You will contribute to the overall health and well-being of the local and global environments.

Considering Your Ecological Footprint

You are on a holiday at a sandy beach. To go for a dip, you have to walk over the sand to get to the water. By doing this, you have an impact on the sandy surface, although not a serious one. The total area of your footprints shows how much you disturbed (or impacted) the sand.

A similar idea is used to measure your impact on Earth and its resources. It is your **ecological footprint**. It is much bigger than the area of your normal footprint or even all the footprints you could make in a day at the beach.

Turn to pages 29 to 31 of the textbook and read "Your Ecological Footprint" and "Impact Here and There."

1. Write definitions for the terms *sustainable* and *ecological footprint*.

2. Explain the statement "North Americans do not live in a sustainable manner."

3. How much land would be required to allow all people to live the way North Americans do?

4. Identify the pictures that illustrate the smallest ecological footprints in Figures 1.23 and 1.24.

5. Ecological footprints can be expressed quantitatively and qualitatively. To find out what these terms mean, read page 458 of the textbook. Then do questions a. to f. of "Instant Practice."

6. Have these questions got you thinking yet? Well, then, keep it up! Answer "Pause and Reflect" on page 31 of the textbook.

Compare your responses with those in the Appendix, pages 97 and 98.

Going Further

Calculate your personal ecological footprint. Try "Internet Connect" at the bottom of page 31 of the textbook.

How much energy does it take to make a hamburger for a fast-food outlet? Remember, the more energy that is required, the larger the ecological footprint! In the next activity, you will compare the ecological footprints of three different choices for lunch.

(1) a fast-food hamburger

(2) a hamburger or sandwich made at home with store-bought ingredients

(3) a sandwich made with home-grown ingredients

Find Out Activity: Putting Your Foot in Your Mouth

Read the entire activity on page 32 of the textbook.

If possible, have your friends, family, or home instructor participate in the activity with you. If you do the activity on your own, have your home instructor check to make sure your flowchart makes sense.

Copy the following table into your notebook, and complete it as you work through the activity. You will find it useful for step 5 of the Procedure.

Costs in Energy and Resources for Different Meals

Type of Hamburger or Sandwich	Number of Chips Used
fast-food hamburger	
hamburger or sandwich made at home with store-bought ingredients	
hamburger or sandwich made at home with home-made ingredients	

7. Carry out the activity as outlined in the Procedure. Then answer questions 1, 2, and 3 of "What Did You Find Out?"

Check your responses with your teacher or home instructor.

Reduce, Reuse, Recycle (and Recover)!

Imagine having a friend over at your house. She brings in chunks of mud on her shoes. When you sit down for a meal, your friend tosses food scraps over her shoulder. Later, as you do some homework, she crumples up some paper and just throws it under the table. She's not very nice, is she? If this keeps up, it wouldn't be long before your house is no longer suitable to live in.

You should dispose of waste properly, not only inside your home but outside it too. That way you also reduce the size of your ecological footprint. But there's more to it. The four Rs for waste management will help you to think about ways you can cut down on the amount of garbage you produce and how you dispose of it.

- **Reduce**
- **Reuse**
- **Recycle**
- **Recover**

Turn to page 33 of the textbook and read "Reduce, Reuse, Recycle!"

The fourth R, recover, is not mentioned in the textbook. Recovery is mainly a concern for businesses and industries. It does, however, have applications at home as well. Here are some examples of recovery:

- using methane produced by the breakdown of wastes in garbage dumps to heat buildings
- using wood shavings as bedding for domestic animals and pets
- using waste materials from vegetable preparation or growth to feed animals
- creating compost to be used as garden fertilizer

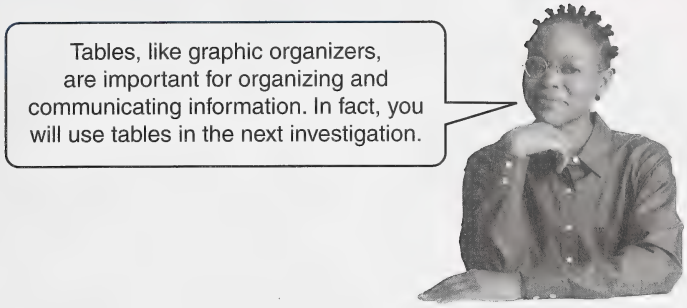
Turn to page 35 of the textbook and read "Career Connect" and "Making the Connection."

8. Which of the four Rs does making sweaters out of pop bottles represent?

9. Why did the early settlers destroy the swift fox's habitat?

Compare your responses with those in the Appendix, page 98.

Developing Skills—Tables


Tables, like graphic organizers, are important for organizing and communicating information. In fact, you will use tables in the next investigation.

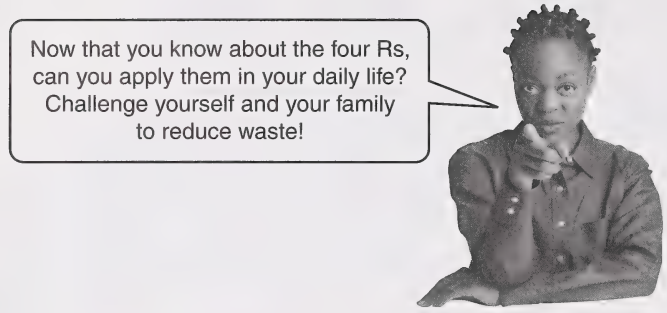
Turn to pages 475 and 476 of the textbook. Information on basic table preparation is given. Read "Making a Table" and "Drawing Data Tables by Hand."

10. Do the "Instant Practice" on page 476. Make sure you meet all the stated requirements. Be sure your title is specific to the information. Plan ahead. Be sure your work is neat. Make the cells of the table an appropriate size for the information you store. If you prefer, use a computer to prepare your table (or any future tables).

Compare your response with the one in the Appendix, page 99.

Find Out Activity: Mapping Home

Are you ready for more? Turn to page 36 of the textbook and complete "Find Out Activity: Mapping Home." This will give you the opportunity to analyze your personal environment.


Now that you know about the four Rs, can you apply them in your daily life? Challenge yourself and your family to reduce waste!

You may want to start your waste-reduction diary early—when it is convenient for you. Scan the next investigation to get a head start.

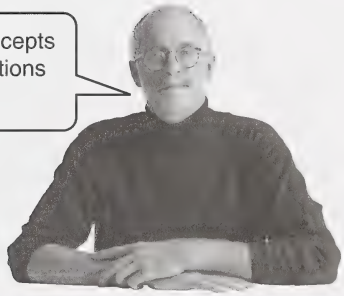
Investigation 1-C Waste-Reduction Diary

First, read the entire investigation on page 34 of the textbook. Then follow the steps of Procedure. If possible, have your family participate with you as you do the steps.

You will need to make a table to store your data as you collect it. Your table must meet all the requirements shown in "Skill Focus 10." (You worked through this in question 10.) A rough sample is provided in the investigation on page 34 of the textbook.

end of investigation

You have now completed the new concepts for this lesson. Do the following questions to check your understanding.



11. Answer questions 1 to 4 of "Topic 3 Review" on page 36 of the textbook.

Compare your responses with those in the Appendix, pages 99 and 100.

Looking Back

Choices and responsibilities—what you do really does impact your environment, either for good or for bad.

Your work in this lesson has helped you recognize that your everyday decisions impact your environment. You've used ecological footprints to identify how human decisions and activities impact on the environment. You applied the concept of environmental choices to the topic of waste management and you completed a waste-reduction diary.

Section 1 Review

To review the concepts covered in this section, answer the following "Wrap-up: Topics 1–3" questions on page 37 of the textbook.

1. Answer question 1 of "Reviewing Key Terms."
2. Answer questions 2 to 6 of "Understanding Key Concepts."

Check your responses with your teacher or home instructor.

Conclusion

In this section, you identified interactions within an ecosystem. You recognized adaptations of living things that help them meet unique needs. You also studied changes in the environment due to human activity. You identified ways in which you can take personal responsibility for protecting the environment.

The cartoon here depicts an interaction. Whose tree is it anyway? Is it the beaver's or is it the lumberjack's? In a world of limited resources, the needs (and even the wants) of people often override the needs of other organisms. So, things do not look good for the beaver.

You cannot do much to settle the beaver-lumberjack issue, but you can make responsible environmental choices. You can choose to keep your personal ecological footprint small. In the next section, you will discover how energy and matter moves through and interacts with the environment.

Turn to pages 3 to 7 of Assignment Booklet 1A and answer questions 5 to 9.

Section 2

The Flow of Energy and Matter

Have you experienced a rushing wind blowing your hair and clothing? This flow of energy and matter is one most people have had. It's normal that you don't give it a second thought. Lots of things involve you in the flow of energy and matter. Have you turned on a light switch? Have you burned your finger roasting marshmallows over a campfire? Have you watched a river flow between its banks?

In this section, you will become aware of the flow of energy and matter through an ecosystem. You will focus on the interactions and interdependence of your environment's living and non-living parts. Natural energy and matter cycles will be introduced and tied to the effects of pollution on living things. An emphasis will, once again, be placed on methods used by individuals and groups to repair, prevent, and minimize negative human impacts.

Lesson 1: How Organisms Interact

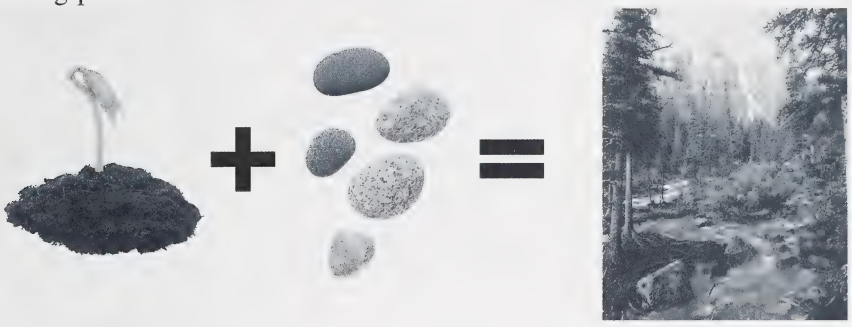
It is easy to see that these students are interacting. Each plays a role—storyteller, joker, listener, helper, and so on. You, too, have roles you play in your family, school, and community.

The focus of this lesson is the types of roles and interactions that occur in natural habitats. Interactions can happen among living things and non-living things. When viewed together, these roles and interactions create an ecosystem.

Interacting

Look at the space you call home. Everything you see will fit into one of two categories: living or non-living. If you were to describe your home, you would use words like *mother*, *bath towel*, *pet*, *food*, *furniture*, and *door*. Words like these may also refer to the roles and interactions of the living and non-living things around you. You can imagine complex webs of events that would tie each of these things together to create the phenomenon you call "home."

Organisms have similar "homes." There are living and non-living parts to them. There are interactions among these parts. The collection of parts and their interactions define an **ecosystem**. When ecologists describe an ecosystem, they need to know what is in it. They also need to know all of the interactions between the living and non-living parts.



Living (Biotic) **Non-Living (Abiotic)** **Ecosystem**

Turn to page 38 of the textbook. Read the introduction of "Topic 4: How Organisms Interact." You will see how interdependent components combine to create a complex whole.

Now, turn to page 40 and read "The Roles of Organisms in an Ecosystem."

1. Write definitions for the following terms:

- *interact*
- *abiotic*
- *producer*
- *herbivore*
- *predator*
- *omnivore*
- *biotic*
- *niche*
- *consumer*
- *carnivore*
- *prey*

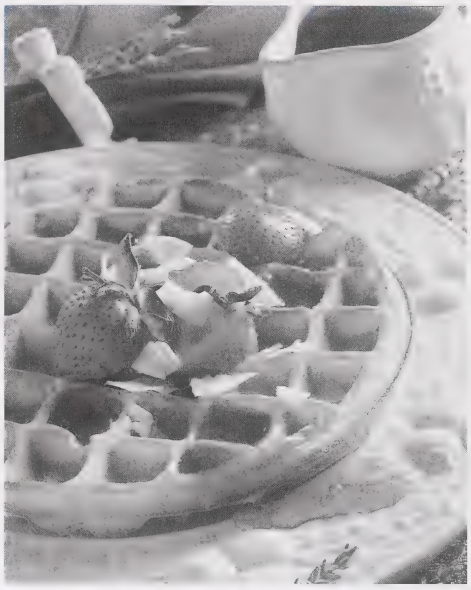
2. Do "Pause and Reflect" on page 40 of the textbook.

Compare your responses with those in the Appendix, pages 100 and 101.

Turn to pages 1 and 2 of Assignment Booklet 1B and answer questions 1 and 2.

Developing Your Investigative Skills for Science

Note: Refer to this part of this lesson as you practise your investigation skills throughout the module.



Did you know that writing recipes involves some investigative skills, like those in science? Terry wants to surprise everyone by making waffles for his family for breakfast tomorrow. Terry has made waffles before, but they did not turn out well. They fell apart when his family was spreading butter and syrup over them. This time, Terry thinks he should do a little investigation this evening. Maybe he could get a little help from one of his parents.

Terry suspected the amount of water added to the ingredients was wrong. He made several portions of mix using different amounts of water. He tried using 400 mL, 500 mL, and 600 mL of water in the mix. Then he tested to see which mix worked best. (Which waffle held together and tasted the best?)

Variables are the factors that affect an investigation. Terry is testing how the volume of water affects the strength of the waffle. For Terry, the volume of water is the **manipulated variable**. The strength of the waffle is the **responding variable**.

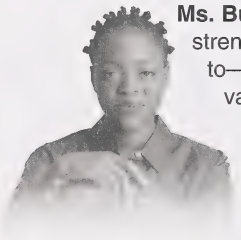
manipulated variable: a variable that is changed on purpose to see what effect the change will have on the responding variable

responding variable: a variable that changes in response to a change of the manipulated variable

Mikaila: Why is the variable you change on purpose called the manipulated variable?

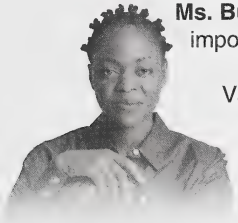
Ms. Burton: The word *manipulate* is another word for "change," "manage," or "handle." In doing the investigation, Terry intends to manipulate the volume of water to see what happens. He is directly changing this variable.

Mikaila: Okay, that makes sense. Now, why is the other variable called the responding variable?



Ms. Burton: Once Terry selects the volume of water, he cannot select the strength of the waffle. There is a specific value of strength that *responds* to—or at least you think it will—to the volume of water. The responding variable is the variable that takes on values that respond to the value of the manipulated variable.

Mikaila: I see. The terms at first seemed a bit . . . well . . . intimidating. They sure help in talking about an investigation, though. But will you really find out the role of water in the quality of the waffles just by thinking about manipulated and responding variables? What if the temperature of the waffle iron changes during the investigation? What if you used an extra egg in one of the batches? or a little less flour in another? Then you really don't know why the waffles hold together well.



Ms. Burton: You just hit on something very important to investigations like this.

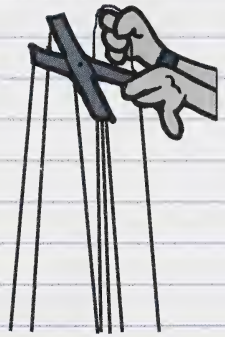
controlled variable: a variable that is not allowed to change

Variables you can easily overlook are **controlled variables**. In the waffle investigation, everything else must be fixed. That means variables like the temperature of the waffle iron must be kept constant. Without controlled variables, the investigation would not give reliable results.

Turn to pages 458 to 461 of the textbook. Read "Skill Focus 6: Scientific Inquiry." You will learn more about variables and investigative skills.

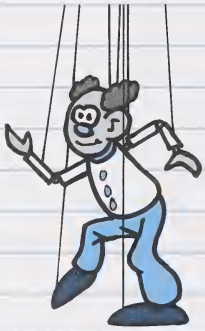
After reading "Skill Focus 6: Scientific Inquiry," one student made the following notes. The pictures are a visual key to keep the types of variables straight.

1. Manipulated Variable (MV)



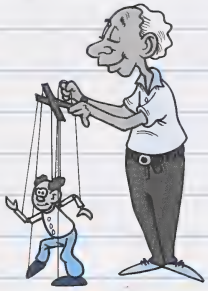
This variable is purposely changed. It is written into the data table before doing the investigation. To find the manipulated variable, ask yourself the question, "What am I going to purposely change?" Remember, you plan the changes before you do the investigation. These changes will come first in time. You will write them into the first column of your data table before you do the investigation. You expect the changes in the manipulated variable to cause changes in the responding variable.

2. Responding Variable (RV)



This variable is expected to change during the investigation. It responds to the changes made to the manipulated variable. It cannot be written down before the investigation. It is measured and recorded during the investigation. To find the responding variable, ask yourself, "What will I be measuring and recording during the investigation?" The responding variable comes second in time. You will record these observed changes in the second column of your data table.

3. Controlled Variables (CV)



These are all the other significant (important) variables. They must be kept the same (**constant**) throughout the investigation **to be fair**! To determine the controlled variables, ask yourself, "Would the investigation be **fair** if I. . .?" Think of factors that could change your results (or would make them difficult to interpret) if they did not remain constant throughout the investigation.

Refer to "Skill Focus 6: Scientific Inquiry" on pages 458 to 461 of the textbook.

3. Write a definition for the following terms:

- *variable*
- *manipulated variable (MV)*
- *responding variable (RV)*
- *controlled variable (CV)*
- *control*

4. Carefully study the experiments illustrated in the top left corner of page 460. In experiment (b), what are the following?

   a. the purpose of the experiment

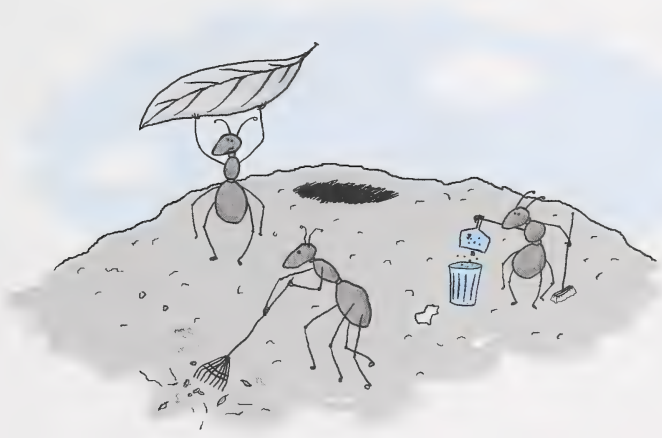
   b. the manipulated variable

   c. the responding variable

Check your responses with your teacher or home instructor.

Preferences, Niches, and Ecosystems

See the hardworking ants? Okay, this may be a little unrealistic, but each of these ants is performing a different role in its community. That is, each has somewhat of a different niche. Real ants, as a species, also have a **niche**—a niche within the ecosystem.



What niche does an ant species have within its ecosystem? Well, they are prey for some species and predators of others. They move seeds around; burrow through the soil, increasing aeration and water content; compete with other insects; prevent plant species from growing on their hills; and scavenge dead plant and animal material from the surrounding areas. The ants' specific needs, adaptations, and preferences would influence where they live and how they behave.

Species usually prefer specific abiotic conditions. These conditions help them meet their basic needs; they help them survive in their ecosystem. These preferences contribute to the definition of their niche. What does the niche of a species or organism tell you? It lets you see their importance to that ecosystem.

In the next investigation, you can apply what you have learned about preferences, niches, and ecosystems. It involves a natural cycle that has been studied since the mid 1800s. The cycle concerns the hare and the lynx.

Investigation 1-E What Goes Up Must Come Down

Turn to page 41 of the textbook and read the investigation. Pay careful attention to the information given in "Think About It."

5. Answer the following on page 41 of the textbook.

   a. questions a. to d. of "What to Do"

   b. questions 1 and 2 of "Analyze"

Compare your responses with those in the Appendix, page 101.

end of investigation

Food Chains and Food Webs

On a typical day you might help with chores around the house, go shopping, or go for a bike ride. Where does the energy to do these activities come from? It comes from the food you eat.

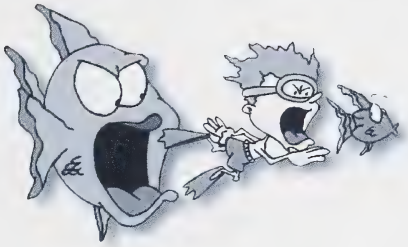
Say you had a hamburger for lunch. You got some of your energy from the meat. But, where did the cow that was raised for the hamburger get its energy? The energy came from the grass the cow ate. Where did the grass get its energy? From the Sun! You can illustrate these energy and nutrient links between organisms by creating a **food chain**. The following graphic organizer describes the transfer of energy (or **energy flow**) from the Sun to you after eating a hamburger.

Sun → grass → cow → you

Open your textbook to page 42 and read "Food Chains."

6. Define the terms *food chain* and *energy flow*.

Do you think you would like to participate in this food chain?



7. A plant absorbs 1000 units of energy from the Sun. It is eaten by a mouse, which is eaten by a snake, which is eaten by a hawk. The hawk receives only 75 of the original 1000 units. Explain how energy is "lost" as it moves up a food chain.

8. Create a picture of how cows use the energy from their food. Follow the instructions in "Drawing a Circle Graph" on pages 479 and 480 of the textbook.

Compare your responses with those in the Appendix, pages 101 and 102.

Food Webs

A web, much like a spider's web, is a good model to represent the energy flow in an ecosystem. That's because energy flow in an ecosystem is much more complex than a food chain might suggest. Why? It's because an ecosystem is an intricate "web" with many interactions.

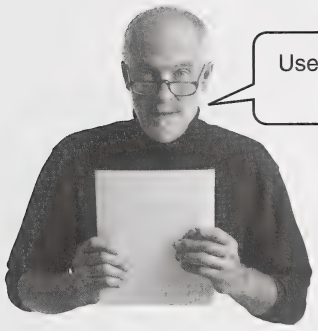
When many food chains link together in an ecosystem, they make a **food web**. A food web tells more of the story—that is, it gives a more complete picture of energy flow.

Read "Food Webs" on page 43 of the textbook. Look carefully at the food web in Figure 1.32. Can you trace out one or two food chains within the food web?

Take note of the following features of food webs:

- Producers are at the bottom of each food chain.
- The arrows are really energy-flow arrows. The arrows point from what is being eaten to what eats it. This is the direction of energy transfer.
- Organisms can have many connections throughout the web. They can occupy more than one food level (or trophic level).

> A food level, also called a trophic level, is one of the levels of a food web. Each food level represents organisms that are the same number of steps away from the primary producers.



9. Use the information in the following table to build a food web. Include each of the generalized categories of consumers named. Include bushes and herbaceous plants, like grasses and weeds, in the web as generalized producers. If you need more information, use other resources, like the local library or the Internet. When you draw a food web, you can use the names of specific species or groups rather than drawing pictures.

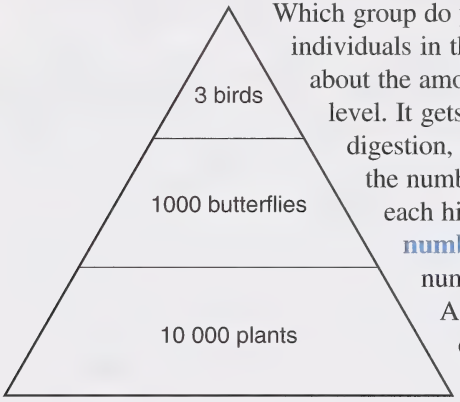
Building a Simple Grassland Food Web

Consumer	Food Source
coyotes	small rodents, hares, insects, berries, and grouse
badgers	ground squirrels, mice
ground squirrels	grasses, weeds
grouse	leaves, buds, berries, grasses, weeds
hawks	hares, ground squirrels, mice, insects, grouse
insects (herbivores)	grasses, weeds, berries
mice	seeds, grasses, weeds, berries, insects

Compare your response with the one in the Appendix, page 102.

Pyramid of Numbers

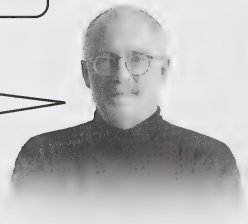
In this photograph, the butterfly is drinking the nectar produced by the flower. The plant gets its energy from the Sun through photosynthesis. The butterfly gets its energy from the plant. What do you suppose eats butterflies? If you answered birds, for example, you are right. This food chain shows the direction in which energy flows. It does not give any sense of the numbers of organisms at each level in the chain.



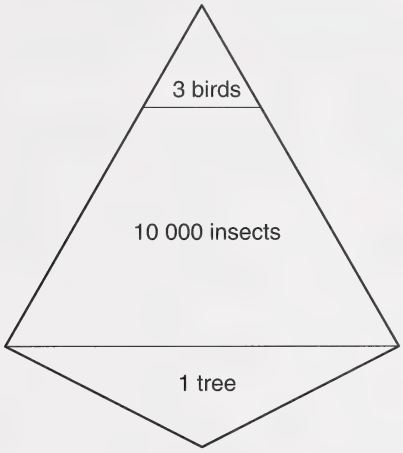
Which group do you think would have the greatest number of individuals in the plant-butterfly-bird food chain? Think about the amount of energy lost at each trophic (food) level. It gets used for growth, maintenance, movement, digestion, and reproduction. Because energy is lost, the number of individuals that can be supported at each higher level must go down. A **pyramid of numbers** shows the relationship between the numbers of organisms involved in a food chain. A sample of a pyramid of numbers an ecologist might use is shown here.

Wait a minute! The numbers don't always tell the story. Some organisms are huge and others small. Take the anteater and the ant. It's like comparing apples and oranges.

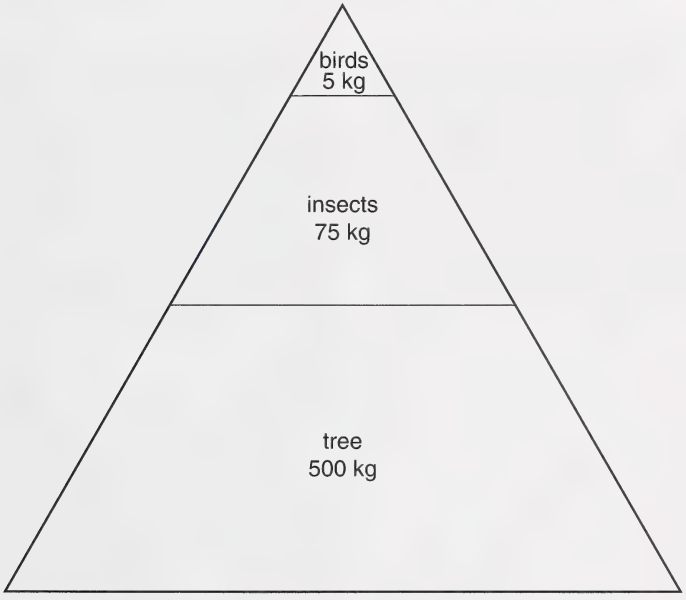
Occasionally, when individual organisms are very small or large, a pyramid of numbers is not a good way to show how much energy is used as it moves up a food chain. To overcome an inconsistency in size, ecologists use a pyramid of **biomass**.



Suppose you looked at an ecosystem where insects feed on a fallen tree. For this example, the pyramid of numbers could look like the following.



Pyramids of numbers can be misleading. Notice how the second level seems larger than the producer level. This just cannot be. See what happens using a **pyramid of biomass**.



In a pyramid of biomass, you use the total mass of each level. You use the mass of the tree; you use the collective mass of the thousands of insects feeding on that tree; and you use the collective mass of the birds eating the insects. Notice that by using biomass, the levels decrease in size (area) as you go up.

Turn to page 43 of the textbook and read "Pyramid of Numbers."

10. Define the terms *pyramid of numbers* and *pyramid of biomass*.

11. Only about 10% of available food energy is passed to the next level in the food chain ("Stretch Your Mind" on page 42 of the textbook). Draw a pyramid of biomass for the following food chain.

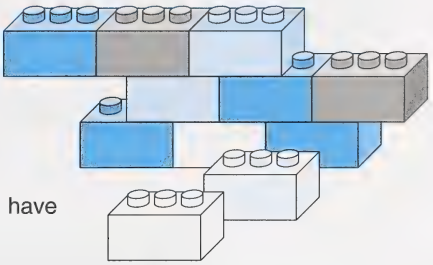
grass → **insects** → **insect-eating birds** → **predatory birds**
(10 000 kg)

Compare your responses with those in the Appendix, page 103.

Going Further

Would you like to find out what an owl had for dinner? Maybe your home instructor can obtain some owl pellets. Maybe you can find some under an owl's nest or roost. Try the truly engrossing "Find Out Activity: What Was for Dinner?" on page 44 of the textbook.

Cleaning Up: Scavengers and Decomposers



Ms. Burton: Imagine starting with a large tub of building blocks, like *LEGO*™. You keep building new objects without breaking any down. What will eventually happen?

Mikaila: You will run out of building blocks.

Ms. Burton: To build more objects, what would you have to do?

Mikaila: You cannot keep buying more. So you'd have to break your old objects down so you can reuse the blocks.

Ms. Burton: That's right! The building blocks of nature are particle-size. Nature's tub of building blocks is vast. However, it is still limited.

Mikaila: I get it. In natural ecosystems, living things have to be reduced to particles again. It's how new generations of living things can be made.

Ms. Burton: Yes. This recycling of matter is left out in food chains and food webs. These are primarily used to show energy flows. Gulls and mushrooms break things down for reuse. There are many examples found in most ecosystems.

Food webs show how nutrients and energy move from producers to several levels of consumers. In an ecosystem **scavengers** (like gulls) and **decomposers** (like mushrooms) complete the nutrient cycle. They break down wastes and dead organisms at each step in a food chain. These nutrient "blocks" are returned to the soil for plants to use again.

Turn to pages 44 and 45 of the textbook and read "The Clean-Up Squads: Scavengers and Decomposers." You will learn more about the roles of scavengers and decomposers in an ecosystem.

12. Where do decomposers fit in a food chain? Copy the chain given. Add the decomposers and the nutrients they release where you think they belong.

grass → deer → cougar → magpie

Compare your response with the one in the Appendix, page 103.

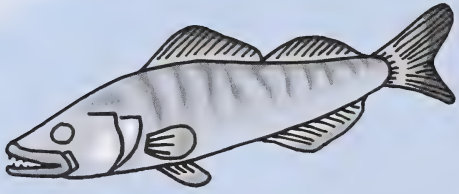
Going Further

Check out "Stretch Your Mind" on page 44 of the textbook.

Read "Across Canada" on page 48 of the textbook. Why does Kevin Vessey call the bacteria that he studies "good bacteria"?

Would you enjoy creating your own investigation? Complete "Investigation 1-F: Don't Waste It!" on pages 46 and 47 of the textbook.

This next selection is really fishy! Research the niche and history of a disappearing fish. Turn to page 48 of the textbook. Do "Find Out Activity: No Fishing Allowed."



13. Answer questions 1 to 4 of "Topic 4 Review" on page 48 of the textbook.

Compare your responses with those in the Appendix, page 104.

Looking Back

In this lesson you studied some of the ways organisms interact in their ecosystem. You discovered that each organism occupies a niche or group of niches. You were then introduced to the flow of energy through an ecosystem. You saw how the energy and nutrient cycle is completed with the help of scavengers and decomposers.

Turn to pages 3 and 4 of Assignment Booklet 1B and answer questions 3 and 4.

Lesson 2: Cycles in the Environment

You know that bicycle wheels go around and around. Did you know that there are many natural cycles in the environment? Earlier, you studied how plants use waste products from their respiration to produce glucose during photosynthesis. This then provides the energy for respiration. In Lesson 1 of this section, you analyzed the lynx-hare (predator-prey) cycle. You studied the cyclical flow of nutrients through the interacting living and non-living parts of an ecosystem.

In this lesson you will recognize and identify the various parts of two other natural cycles: the carbon cycle and the water cycle. The relationship of these cycles to the transportation of pollution through local and global environments concludes the lesson.

The Carbon Cycle

Mr. Casey: These workers are working in an underground mine. What does this have to do with carbon?

Miguel: They are working in a coal mine. Coal is mainly carbon.

Mr. Casey: Yes. Can you think of any other places where you see carbon?

Mikaila: Whenever I burn my toast, the black is carbon.

Miguel: There's carbon left on the grill after using the barbeque.

Mikaila: A pencil is mainly carbon. The soot in our fireplace is carbon.

Mr. Casey: You have identified many visible forms of carbon. But there are many forms you can easily overlook.

Mikaila: Such as?

Mr. Casey: Sugar, the type you add to your cereal for your sweet tooth. Diamonds are also carbon-based.

Miguel: That's surprising. I thought substances containing carbon would be dark.

Mr. Casey: Here's another form of carbon, and it's invisible. It's a gas called carbon dioxide. It comes from the burning of fuels and from the respiration of living things. In fact, you and I breathe out carbon dioxide.

Miguel: Doesn't carbon dioxide add to the greenhouse effect and global warming?

Mr. Casey: Yes. Those climate effects give carbon dioxide a bad rap. Yet, carbon dioxide is essential for life. Every living thing contains carbon.

Mikaila: So, every cell in my body contains carbon.

Mr. Casey: Yes, carbon is everywhere there is life on Earth. You could say carbon is the most important element—well, fundamental substance—on Earth.

Mikaila: Yes, without carbon we would not be here.

Carbon is one of the building blocks essential for life. Turn to page 49 of the textbook and read about the importance of the **carbon cycle** to living things.

1. Define the terms *carbon cycle* and *pH*. Study the pH scale in Figure 1.43 on page 52 of the textbook. It will be referred to in the next investigation.

2. Why is carbon essential for all life to exist?

Compare your responses with those in the Appendix, page 105.

Believe it or not, snails—like all other organisms—play a part in the carbon cycle. In the next investigation you will have an opportunity to practise your investigative skills again. You will design an experiment to show that snails or plants give off carbon dioxide when they respire.

In Module 2 you will see that plants and animals break down glucose to obtain energy. The waste products of this process, called respiration, are gaseous water and carbon dioxide. When carbon dioxide dissolves in water, it produces carbonic acid. If the carbonic acid concentration increases, the pH lowers.

Recall that pH is a quantitative measure of the strength of an acid.

An increasing concentration of carbon dioxide can be observed indirectly. You can use a pH indicator, such as bromthymol blue. Put 10 drops of bromthymol blue indicator into 15 mL of water in a tall, narrow, clear, glass container. Insert a straw into the mixture and gently bubble your breath through it. Observe the colour of the mixture every minute for about 5 minutes.

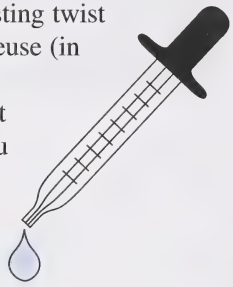
Be careful. Bromthymol blue is a dye and can stain your hands and clothing. Make sure you do not suck any of the liquid into your mouth.

Investigation 1-G Telltale Snails

Read through the entire investigation on page 50 of the textbook.

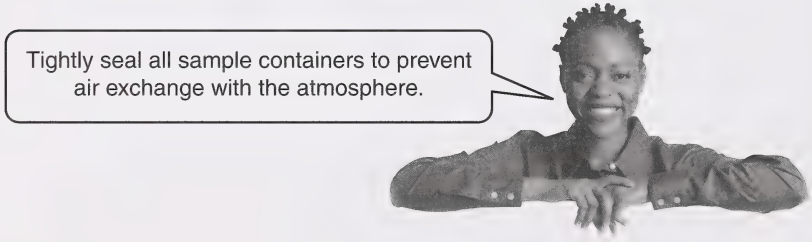
Snails or water plants can be obtained from a local pond or pet store. **Note:** Snails require dechlorinated water. If you buy snails, obtain at least 0.5 L of tank water with them or use pond water or water that has been in an open container for at least 24 hours. You could also buy and use dechlorinator. Bean seeds can be obtained from many sources. You can design your experiment around three organisms—the snail, water plants, or germinating seeds.

Using aquatic plants, rather than snails, can add an interesting twist to your investigation. In light, green plants immediately reuse (in photosynthesis) the carbon dioxide they release through respiration. In darkness, however, photosynthesis does not occur. How would this affect your results? How could you test the light (photosynthesis and respiration)/dark (respiration only) relationship?



If you experiment with an aquatic environment, use 20 drops of bromthymol blue indicator in 200 mL of water.

A third investigative alternative could be germinating seeds. Use peas or beans in a closed environment (sealed jar). You could place about 40 pre-soaked (for at least 24 hours) seeds on a wet paper towel in the bottom of a clear, glass jar. Place 15 mL of water and 10 drops of bromthymol blue indicator solution in a test tube. Slide the tube carefully to the bottom of the jar and lean it against the inside wall. You might even decide to use modelling clay as a base to prevent it from tipping. **Note:** Seedlings take several days to sprout and begin growing.



Going Further

The observations you make will be qualitative (using descriptive words). With your home instructor's permission and assistance, you could gather quantitative (precise numerical) data as well. You could analyze each of the samples that turned yellow by adding drops of dilute ammonia. Ammonia neutralizes the carbonic acid. The bromthymol blue will return to a blue colour when all the acid in an experimental sample has reacted. Slowly add drops of ammonia while gently stirring the water. Carefully count the number of drops needed to turn the experimental sample about the same colour as your control. Record the results.

3. List your manipulated variable (MV), responding variable (RV), and all significant controlled variables (CVs).

Check your response with your teacher or home instructor.

Turn to page 5 of Assignment Booklet 1B and answer questions 5 and 6.

4. Create a procedure. Discuss any difficulties with your home instructor as they arise. You may find it useful to create a materials list and/or a diagram of your procedure.

5. Prepare a data table to organize and store your information. Check and discuss your written work with your home instructor. Once your work has been approved, perform your investigation.

6. Answer the following questions on page 50 of the textbook. Your answers will apply to the organism you experimented with.

   a. questions 2 and 3 of "Analyze"

   b. question 4 of "Conclude and Apply"

Check your responses with your home instructor.

end of investigation

The Water Cycle

In Section 1: Lesson 1 you identified four basic needs of all living things. One of these basic needs is water. Like carbon, water moves continuously through the environment in a non-ending path called the **water cycle**. The water cycle is made up of four major components:

- **evaporation**
- **transpiration**
- **condensation**
- **precipitation**

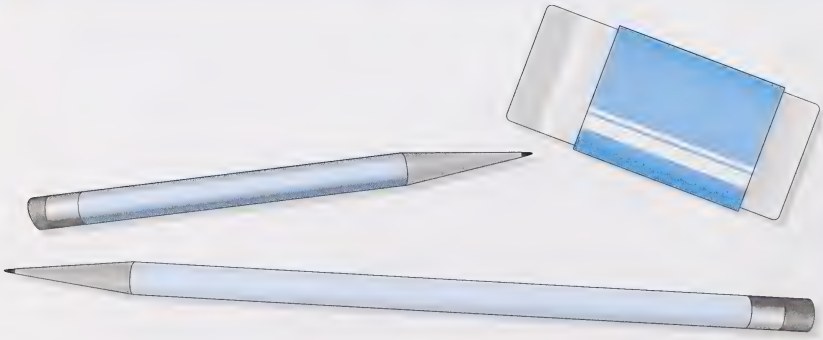
Through evaporation and transpiration, water moves from Earth's surface into the atmosphere. Condensation and precipitation move water back from the atmosphere to the land. Water moves around the globe in the air, as run-off, or as ground water.

Turn to page 51 of the textbook and read "The Water Cycle."

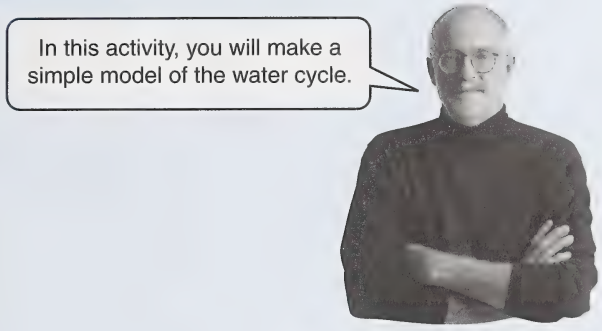
7. Define the following terms:

- *water cycle*
- *transpiration*
- *precipitation*
- *run-off*
- *evaporation*
- *condensation*
- *ground water*

Compare your responses with those in the Appendix, page 105.



Find Out Activity The Water Cycle



Procedure

step 1: Put 500 mL of water into a large bowl.

step 2: Cover the bowl tightly with plastic wrap.

step 3: Put the bowl in a sunny (or very warm) location for several hours.

step 4: Make observations as the Sun moves or sets, causing a decrease in air temperature.

Observations

8. Record your observations in sentence or point form.

Conclusion

9. Which part of your model demonstrates each of the following processes?

- condensation
- precipitation
- evaporation

Compare your responses with those in the Appendix, page 105.

Mobile Pollutants

Austin: In the picture, I see dead fish and smoke coming from some sort of factory. How are they connected? If pollutants go up the chimney and away into the air, isn't it "out of sight, out of mind"?

Ms. Burton: Actually, pollutants have a way of "hitching a ride." They get around.

Austin: So, what goes around comes around?

Ms. Burton: Yes, that sort of applies to pollutants.

So far in this lesson, you have learned about two natural cycles that are part of the global environment. Unfortunately, **pollutants** can also move through an environment, ecosystem, or organism.

Turn to pages 52 and 53 of the textbook and read "Pollution in the Environment" and "The Movement of Pollution." Read "Did You Know?" on page 53 of the textbook as well.

10. Define the terms *pollution*, *pollutant*, and *acid rain*.

Review the definition for *pH*.

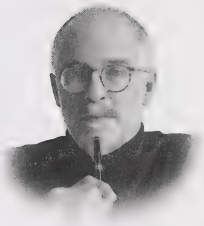
11. List four examples of pollutants that move through the environment.

Compare your responses with those in the Appendix, page 105.

Going Further

Test the acidity levels of the water in your area. If you have access to pH paper, turn to page 52 of the textbook. Try "Find Out Activity: Checking the pH."

Bioaccumulation



Mr. Casey: Pancakes with maple syrup at breakfast—what a treat! Sweet-water sap of a North American sugar maple was used by the First Nations of the Great Lakes and St. Lawrence. People concentrate this sap through an evaporation process to get the sweet, delicious syrup.

Some pollutants become concentrated, too, when they are released into the atmosphere. The difference is they become concentrated through a natural process, not through an artificial one.

Tara: You would think that pollutants would become diluted as they are released into the atmosphere or into a lake.

Mr. Casey: Yes, most do and decompose. Unfortunately some don't. They become concentrated and dangerous. For example, an insecticide called DDT—when it was still used—moved up the food chain and became more and more concentrated.

Rachel Carson was a biologist and conservationist. Her work demonstrated that stable, non-excretable pollutants move up the food chain. DDT is an example of such a chemical. As DDT moved through the food web it became more and more concentrated. As the concentration of DDT increases, the more harmful it becomes.

This process is called **bioaccumulation**. Bioaccumulation makes it very important to understand and reduce the effects of pollution on the ecosystem.

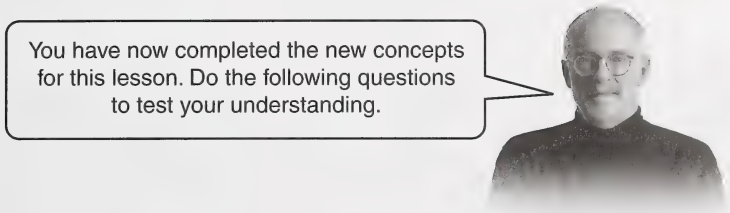
Read "Bioaccummulation" on page 54 of the textbook.

12. Define the term *bioaccumulation*.

13. Draw a food chain that shows how a pollutant, like mercury, can move from micro-organisms to humans. Title it "Bioaccumulation." Quantify each step by writing the number of units of pollutant that might be present in each organism. Base your numbers on the information (orange bars) given in Figure 1.46.

14. Write a sentence or two to answer "Pause and Reflect" on page 54 of the textbook.

Compare your responses with those in the Appendix, page 106.



15. Answer questions 1 to 5 of "Topic 5 Review" on page 54 of the textbook.

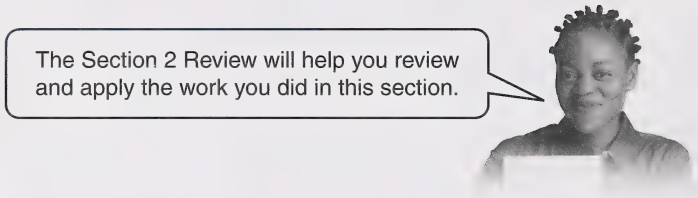
Compare your responses with those in the Appendix, page 106.

Looking Back

In this lesson you explored how matter and nutrients cycle in the environment. You found that carbon and water cycle through an ecosystem. You proved that snails and plants produce carbon dioxide and built a simple model of the water cycle. You also became aware that pollutants can move in air and water throughout the global environment. You then studied how these pollutants can become concentrated as they move up a food chain.

Yet again, you have gained a broadened awareness of the consequences of human interactions with the environment.

Section 2 Review

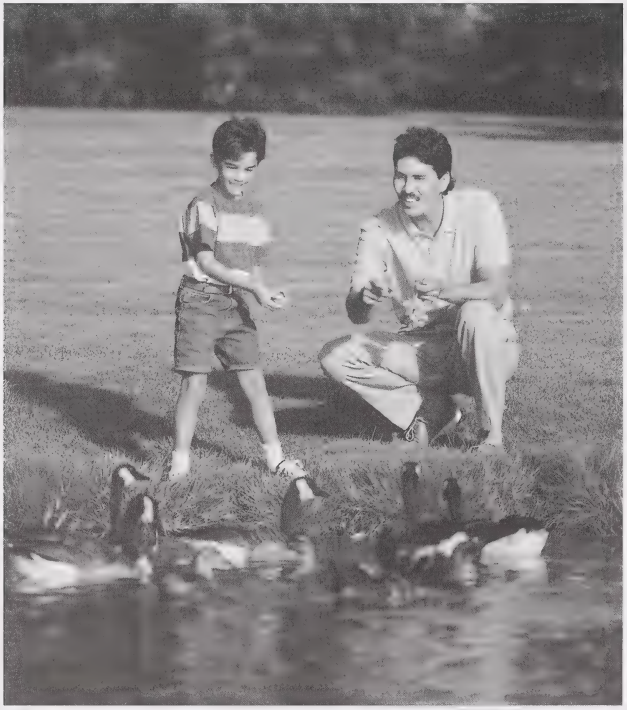


1. Complete the following "Wrap Up: Topics 4–5" questions on page 55 of the textbook.

   a. question 1 of "Reviewing Key Terms"

   b. questions 2 to 7 of "Understanding Key Concepts"

2. A herbicide is used to kill dandelions in a local park one spring. This can affect other organisms in the ecosystem. Predict at least three possible consequences.



Check your responses with your teacher or home instructor.

Conclusion

Picture yourself in a pool at the bottom of this waterfall. Its energy and matter flowing over and around you as you take deep breaths of the fresh, moist air. Birds flutter by, leaves rustle, and frogs croak at the far edge of the pool. You become one with the natural environment.

It's likely that you now have a deeper appreciation for and understanding of the complexities of the ecosystem than you imagined. Your increased awareness of the flow of energy and matter has combined with an expanded knowledge of the roles and relationships that exist among the living and non-living factors in an ecosystem.

Hopefully, your understanding extends beyond the graphically organized patterns—food chains, food webs, pyramids of numbers and biomass, and water and carbon cycles—to a larger picture of interacting, interdependent, living, and non-living components of your ecosystem.

In this section you learned that pollutants move and accumulate in the environment and its inhabitants. In the next section your focus will move to reversing and minimizing harmful human impacts on the environment—scattering and diminishing the threat to your environment.

Turn to pages 6 to 8 of Assignment Booklet 1B and answer questions 7, 8, and 9.

Section 3

Watching Changes in Ecosystems

Every summer, forest fires and grass fires burn across Alberta. Some are caused by lightning, some by industry, some by careless individuals, and some are set on purpose. Residents near the fire fret about their homes and land. People involved in the transportation industry worry about road access. Those involved in forestry worry about the loss of timber.

Did you know that forest fires play a natural part in ecosystem balance? They are important to the long-term maintenance of many ecosystems.

In this section you will study how ecosystems change. You will see that some of these changes happen slowly, while others happen quickly. You will see that some happen naturally, while others are due to human influence. You will discover that human activities can have unintended consequences. You will then examine the effect of adding or removing living things in an ecosystem. Finally, you will gather some ideas about how people can help look after the environment.

Lesson 1: Succession and Change in Ecosystems

One night in 1903, Turtle Mountain, in the Crowsnest Pass, crumbled and slid onto the town of Frank. At least 70 people were killed. About 90 million tonnes of rock covered most of the small, coal-mining community. This historic event, called the Frank Slide, occurred in less than two minutes. There wasn't enough time for people to escape. It changed this area forever.

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The Frank Slide was a very sudden and massive change. However, changes to ecosystems are usually not this rapid. Most happen slowly and continuously over time. Slow ecosystem change is called **succession**. It is characterized by a series of natural changes in both biotic and abiotic factors.

Turn to pages 56 and 57 of the textbook. Read the introductory paragraphs of "Topic 6: Succession and Change in Ecosystems." Continue on pages 57 and 58 of the textbook by reading "Secondary Succession" and the introductory paragraph of "Investigation 1-H: Nothing Succeeds Like Succession." Then examine the photograph on page 59.

1. Define the terms *succession*, *primary succession*, and *secondary succession*.

2. Why are forest fires required to maintain jack pine and black spruce ecosystems?

3. Check out Figure 1.48B on page 57 and the photograph on page 59 of the textbook. Classify these developing ecosystems.

Compare your responses with those in the Appendix, page 107.

Turn to page 1 of Assignment Booklet 1C and answer question 1.

Going Further

Have you watched weeds move into a pile of dirt dumped on the side of a road? Have you seen plants grow into cracks in pavement or a sidewalk? Over a longer period you can watch the ripple of water in a pond be replaced by the ripple of grass in a meadow.

Follow the procedure in "Investigation 1-H: Nothing Succeeds Like Succession" on page 58 of the textbook. You will have a chance to observe your own small ecosystem change over a few weeks.

Changes Caused by Human Activity

As a child, you may have built sand castles, turned the lights on and off in your home, or run through a sprinkler on the lawn. These are all small changes you created in your habitat. As you grow older, your effect on your environment will grow as well. Human activities often cause changes in ecosystems. Ploughing fields and building houses, roads, office towers, and recreational facilities change or destroy ecosystems. Some changes can be predicted; others are unexpected. While some organisms are able to adapt to these changes, others cannot.

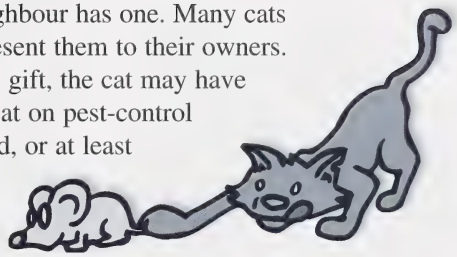
Read "Changes Caused by Human Activity" on page 60 of the textbook.

4. The human need for more food reduced the number of vireos and warblers. Was this reduction predictable?

5. Some animals adapt better to the presence of humans. Compare how wolves and coyotes adapt to having people around.

Compare your responses with those in the Appendix, page 107.

Pest Control



Do you own a cat? Perhaps a relative or neighbour has one. Many cats kill mice and often bring them home and present them to their owners. While a dead mouse makes a very gruesome gift, the cat may have actually done its owner a service. With the cat on pest-control duty, the need for rodent poison is eliminated, or at least reduced. Now, other organisms in the mouse's habitat will not be accidentally poisoned.

People can cause changes in ecosystems by the way they choose to deal with plant and animal pests. Earlier in this module, you learned how using DDT to kill insect pests impacted bird populations. Trying to get rid of one pest harmed other organisms in the environment. There have been many similar examples in the last 100 years. A more current trend is the use of **biological control** rather than chemical pesticides. However, there are risks associated with this practice as well.

Turn to pages 61 and 62 of the textbook and read "Pest Control" and "Biological Control." Then read the introductory paragraph of "Find Out Activity: The Good, the Bad, and the Buggy." Here, you will discover more about biological pest controls.

6. Define *biological control*.

7. What are two possible downsides to using pesticides?

Compare your responses with those in the Appendix, page 107.

Going Further

The black dot spurge beetle is used to control leafy spurge. Ladybugs are used to control aphids. Many other organisms are also used as biological controls in Alberta. Find out more about these organisms. Turn to page 62 of the textbook and do "Find Out Activity: The Good, the Bad, and the Buggy." Share your findings with your family, friends, or home instructor. Refer to the website listed in "Internet Connect." It will help you begin your research on biological controls.

Introduced Species

Have you ever looked at a lawn and seen it brightly spotted with yellow? Many homeowners turn to chemicals to try to control this blight on their green lawns. They have probably tried digging out the dandelions and failed. There don't seem to be any insects or animals that help to keep them in check. To be fair, dandelions do have many uses. There are reports that the Pilgrims introduced them to North America. Dandelions were to supply food and medicine for these settlers of the New World. Most lawn owners wish that dandelions had been kept out of North America. They have spread across the continent because nothing here has kept them in check. Their natural enemies were left behind in Europe. Can you think of any other bio-invaders in your neighbourhood?

New organisms come to live in new places all the time. A species put into an area where it was not originally found is called an **introduced species**. Humans have purposely and accidentally introduced many plant and animal species to ecosystems. Introduced species can be a huge problem. They may be better able to survive. They may reproduce better than natural species. If so, they outcompete them and take over.

Turn to pages 62 and 63 of the textbook and read "Introduced Species."

8. Define *introduced species*.

9. There are many examples of introduced species. Give one example that has remained under control.

10. Study Figures 1.56 and 1.57 carefully. What conclusion about the spread of purple loosestrife can you draw?

Compare your responses with those in the Appendix, page 108.

Species in Danger

The great auk, a marine bird, lived by the thousands on an island off the coast of Newfoundland. Like penguins, these birds could not fly. They were found to be a good source of food, feathers, and even oil. The birds were excellent swimmers, but on land they were slow and ungainly—an easy target. The great auks were hunted for their commercial value. By the 1850s, they were extinct.

Today, many species are in danger of becoming extinct. Often, it's due to human activities.

Review the definitions of the terms *extinct* and *endangered*. Remember, the Appendix contains a glossary that has definitions of the important terms in this module.

Turn to page 64 of the textbook and read "Species in Danger." You will find out more about extinct and endangered Canadian species. Also, note the information provided in "Did You Know?" and "Cool Tools."

11. What are two main reasons for species extinctions?

Compare your responses with the one in the Appendix, page 108.

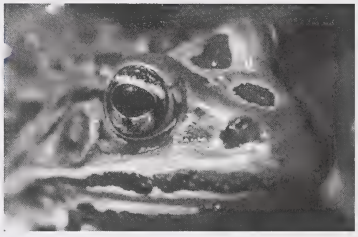
There are many threatened species in Alberta. Human activity has endangered the eastern cougar. The grizzly is locally extinct on the prairies. Humans and their domesticated plants and animals have been bioinvaders of their natural habitats.

Going Further

What is it like to be an endangered animal? With friends or family members, do "Find Out Activity: Endangered Animal for a Day" on page 65 of the textbook. This activity provides an informative model showing the possible effects of an introduced species. Feel free to change the activity slightly so everyone can take part.

You can help! Be part of the solution rather than part of the problem. Do "Investigation 1-I: Keep Them Safe" on page 66 of the textbook. You will choose and study an endangered species in Alberta. You will then develop a plan to help people understand what they can do to prevent the potential extinction of the species you chose. Modify the expectations if you are working alone. Consult with your teacher as you develop your plan. Share your presentation with your family, friends, or home instructor.

Helping Endangered Species



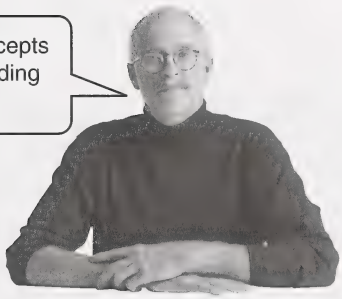
Once, the northern leopard frog was the most widespread frog species in North America. Their numbers began to decline in the mid 1960s. In Alberta, most populations remained healthy until about 1979. Then they mysteriously disappeared from most sites in the central and southern parts of the province. In 1990, only half of the remaining leopard frog populations in Alberta were breeding successfully. The leopard frog has been placed on the Alberta Government's Species at Risk list. It joins animals like the grizzly bear and the cougar. Concerned individuals and groups are taking action to aid these and other threatened species. Their work includes scientific study and monitoring, raising money and public awareness, improving or providing habitat, and establishing and enforcing protection laws. You could become involved in any of these activities. You wouldn't have to do it alone. You could join a group working on these actions.

Turn to page 67 of the textbook and read "How Can You Help?" and "Off the Wall."

12. Many landowners are involved in "Operation Burrowing Owl." What do they do to help burrowing owls?

Compare your responses with the one in the Appendix, page 108.

You have now completed the new concepts for this lesson. Check your understanding by doing the following questions.



13. Answer questions 1, 3, and 4 of "Topic 6 Review" on page 67 of the textbook.

Question 2 is a personal-action option you may want to try. Is there a local issue you may be able to influence?

Check your responses with your teacher or home instructor.

Looking Back

J. FRANKLIN, USDA FOREST SERVICE, 1980

In this lesson you explored the concept of succession and change in ecosystems. You found that change is always occurring. Some changes happen quickly, like Frank Slide and the eruption of Mount St. Helens. Other changes occur more slowly, like primary succession on bare rock or devastated areas.

Forces of nature can be very destructive. They are not the only source of change to Earth's ecosystem. The impact of human activity has led to even more changes. People made some of these changes on purpose. Others were not intended. Humanity has to look after and protect the environment. With the knowledge and skills you have gained, you can now play an important role in this activity.

Turn to page 2 of Assignment Booklet 1C and answer question 2.

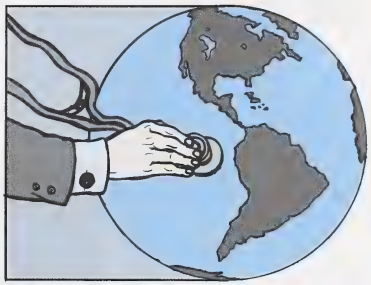
Lesson 2: Environmental Monitoring

Have you ever watched birds? Did you use binoculars or just look out a window? Were they quietly perched on a tree branch or squabbling near a birdbath? Perhaps you have been lucky enough to spend some time observing them in their natural habitat. If so, you may be interested in the Christmas Bird Count. It takes place every year, near the end of December. Enthusuastic birdwatchers from across Canada participate in this population survey. They are given a particular area to visit for the day. They use their binoculars, bird books, and a journal to record their observations. They travel through their assigned area recording the types and numbers of birds they see and hear. The Christmas Bird Count is a simple example of **ecosystem monitoring**.

The Christmas Bird Count helps scientists compare data from one year to the next. It gives them the numbers, types, and locations of birds every year. In this case, they are monitoring a biotic factor. Often, environmental or ecosystem monitoring involves both abiotic and biotic factors. In the final lesson of this module, you will study some of the assessment methods. These include techniques that can be used by groups and individuals. They let you assess the environment's long-term health and the human impact on it.

Monitoring Global Health

Keeping track of the health of Earth's ecosystem is important. What is monitored in an ecosystem? Who does it? How is it done? What have they found? What purpose does environmental monitoring serve?



To start your fact-finding mission, turn to page 68 of the textbook. Read the introductory paragraphs of "Topic 7: Environmental Monitoring."

1. a. Define the term *ecosystem (environmental) monitoring*.

   b. List the four basic categories of ecosystem monitoring. Explain the purpose of each category.

Compare your responses with those in the Appendix, page 108.

Short- and long-term monitoring can be done before, during, and after a change is made to an ecosystem. They can help to predict and/or assess the impacts of that change. The results of these studies can be analyzed and applied to other situations. Some species are more sensitive to change than others. These species can be used as **indicator species**. They provide an early warning of environmental change. Environmental monitoring helps scientists as well as other concerned groups and individuals. They can better understand the needs of organisms. They can use this to balance these needs with human needs and wants. Knowledge and awareness allow for wiser choices.

Turn to pages 69 and 70 of the textbook and read "When Do We Monitor?" and "Long-Term Monitoring Programs." To continue your fact-finding mission, also read "Did You Know?" and "Across Canada" on page 70.

2. Define *indicator species*.

3. Why do some scientists find natural disasters useful?

4. Why are amphibians a good indicator species?

Compare your responses with those in the Appendix, page 108.

Investigation 1-L is coming up soon. You'll have to plan for this one. You may even have to wait a few months. (It might be hard to find plants and animals under 3 feet of snow.) Discuss this investigation with your teacher or home instructor. You may need help finding an undisturbed area. You may even have to travel some distance to get to one. If you don't have plans yet, now would be a good time to talk to your teacher or home instructor.

Going Further

Do you have a favourite animal or plant? Would you like to help it survive? You could get involved in protecting its ecosystem or the global environment. Turn to page 69 of the textbook. Visit the website given in "Internet Connect."

You have learned about monitoring the health of local ecosystems. You have seen how amphibian numbers can be a part of this monitoring. Where does the data come from? Often, it is collected by interested volunteers. In the next investigation you will interpret data they have collected. You will make predictions about the health of amphibians in Alberta.

Check out your local library. You are going to need a number of reference books. They often have a good selection of the books you will need. See if they have a field guide to Albertan or Canadian amphibians. You will also need a good map of Alberta. While you are there, check for these other guides:

- an Alberta tree identification guide
- field guides for insects, plants, flowers, and birds

This would be a good time to obtain these as well!

Investigation 1-J What's the Change?

Read over the investigation on page 71 of the textbook. Then review the information on the bar graphs given on pages 477 and 478. Remember, you can create your graphs (or do the whole assignment) on a computer.

5. a. Complete steps 1 to 3 of "What to Do." Read the directions carefully. **Hint:** Draw your bar graph with all the information on the same graph. For each species, place the bars representing 1997 and 1998 numbers side by side so the data can be compared more easily.

   b. Answer question 1 of "Analyze." For question 1.a., use the 1998 data.

6. Identify the following Alberta amphibians. Use your field guide and what you have learned from your investigation.

Amphibian A

© JOHN WHITE

Amphibian B

© JOHN WHITE

Check your responses with your teacher or home instructor.

end of investigation

Skill Development—Using Classification Keys

key: an arrangement of characteristics designed for the identification of plants or animals

Another important scientific and life skill is using classification keys. Keys can be used in a wide variety of ways and can take several forms. A dichotomous key is one of the simplest. A dichotomous key is a list of choices that leads you through a chain of physical features to an unknown object's or organism's name. At each step in the key, you are given two choices. In a properly written key that includes your unknown organism or object, one choice will be true for your unknown; the other will be false. The true statement will either send you to another pair of choices or it will provide the name of your unknown.

Carefully work through the following sample of a dichotomous key. It was written to distinguish between living things found near wetlands in Alberta. It lets you test for a fish, a spotted salamander, a wood frog, and a leopard frog. (You identified these frogs earlier using a field guide.)

Dichotomous Key

Characteristic	Instruction/ Identification
1. (a) has fins	Fish
(b) does not have fins	Go to 2.
2. (a) has a tail	Spotted salamander
(b) does not have a tail	Go to 3.
3. (a) has a dark wedge on each side of its head	Wood frog
(b) side of head is the same colour as the body	Leopard frog

The fish was easy! As the only animal with fins, it was identified in step 1(a). The wood frog was a little more difficult. I had to follow the chain of true choices from 1(b) to 2(b) to, finally, 3(a).

Now try a somewhat more complex identification.

7. Identify each amphibian given. Use the Identification Key for Alberta Amphibians on page 73 of the textbook. List the steps you take through the key (e.g., 1(b), 2(b), 4(a), 5(b), 6(a), wood frog).

Amphibian A

THEODORE HOBERG

green with black stripes

Amphibian B

THEODORE HOBERG

light and dark green with spotted belly

Amphibian C

THEODORE HOBERG

brown and black

Amphibian D

THEODORE HOBERG

light and dark green with unspotted belly

Check your responses with your teacher or home instructor.

Going Further

Another chance to get involved. Use what you've just learned to find out more about the amphibians that live close to your home. Start your own monitoring program. Complete "Investigation 1-K: Monitor Your Local Amphibians!" on pages 72 and 73 of the textbook. This activity requires the supervision of your home instructor.

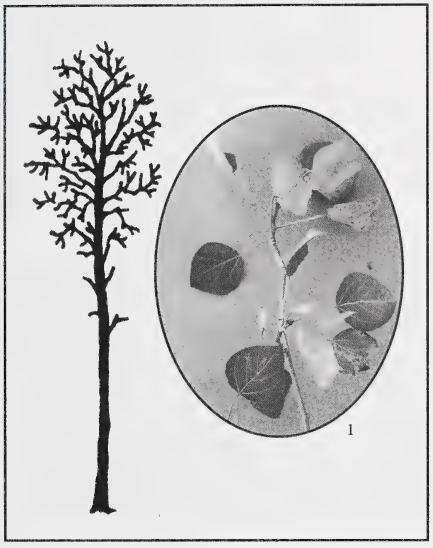
Practising Your Keys

It is not easy to walk into a forest and know what species a tree belongs to. Scientists often identify organisms using classification keys. These keys allow anyone to identify many organisms. Study the dichotomous key that follows. It was written for six Alberta tree species. (You can find them on pages 144 and 145 of the textbook.) The physical characteristics of the tree must be examined closely. As you study each step, note how carefully it was chosen. Each choice clearly separates the current group into two distinct sets.

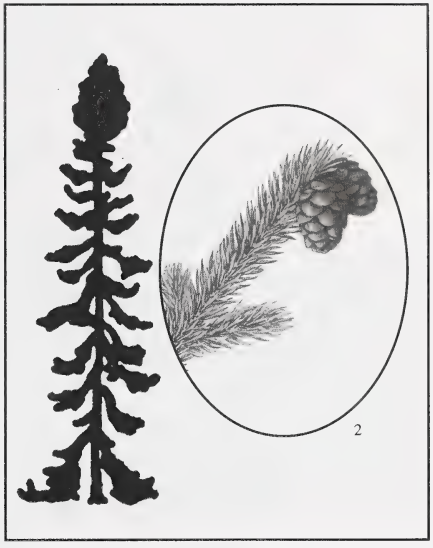
Key for Six Common Alberta Trees	
Characteristic	**Instruction/ Identification**
1. (a) tree has leaves (b) tree has needles	Go to 2. Go to 3.
2. (a) leaves are small, rounded, and smooth (b) leaves have jagged edges and narrow to a point	Aspen Birch
3. (a) needles stay on the tree year round (b) needles turn colour and fall each winter	Go to 4. Tamarack
4. (a) needles are long and far apart (b) needles are short and close together	Lodgepole pine Go to 5.
5. (a) tree is wide and bushy (b) tree is narrow and sparse	White spruce Black spruce

8. Use the key and the information on pages 144 and 145 of the textbook to identify each of the following trees. List the series of steps you followed to find their names.

Tree A



Tree B



9. Did you find it hard to identify characteristics from a picture? What would have made this activity easier?

Compare your responses with those in the Appendix, pages 108 and 109.

[1] Courtesy of British Columbia Forest Service. Reprinted by permission.
[2] Courtesy of Alberta Sustainable Resources Development. Reprinted by permission.

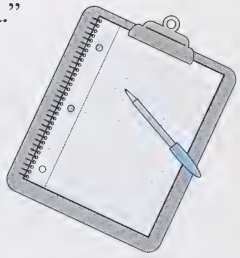
Plotting the Wilderness

Your Halloween candy is sitting in a large bowl on the kitchen counter. You suspect that someone is taking goodies from it. Or, maybe you have been eating more than you realize. How can you know for sure?

Well, you could count each item to get a baseline number (a starting point). You could then monitor your supply by observing the activities of those who enter the kitchen. You could also do a count of the items in your candy bowl at intervals throughout the day. This method of assessing the safety of your candy is very similar to techniques used to determine the current or long-term health of an ecosystem.

The initial count of the Halloween candy gave you **baseline data**. This starting point becomes the standard for the rest of your counts. Scientists often gather baseline data for **permanent plots**. They, too, need a starting point for predictions and future comparisons.

Turn to pages 74 and 75 of the textbook and read "Baseline Data." You will see how to collect baseline data. You will also see how the information can be used in an **Environmental Impact Assessment**.



10. Define the terms *baseline data*, *permanent plot*, and *Environmental Impact Assessment*.

11. Why is it important to collect baseline data?

Compare your responses with those in the Appendix, page 109.

In the next investigation you will collect your own baseline data. You'll compare two areas in your neighbourhood. Choose one that has been disturbed by humans and one that is still a fairly natural area.

You will want to start by looking for two areas that are close to your home. A disturbed area might be a playground, soccer field, lawn, or pasture. You're looking for an area where humans have made a significant impact. An undisturbed area might be a natural woodlot or natural grassland. Carefully read the entire investigation prior to doing it. If possible have your friends, family, or home instructor work on the investigation with you.

Does this apply to you? Don't stop. You can complete everything else in this module. You will be missing the field experience. You should come back to this as soon as you can.

If it's winter time, you may have to put off completion of this investigation. It is less revealing during the winter than at other times. Also, if you live in a city, finding land in its natural state may take time.

Investigation 1-L Comparing Ecosystems

Read the information on pages 76 and 77 of the textbook.

12. Answer the following on page 77.
    a. question 1 of "Analyze"
    b. questions 4 and 5 of "Conclude and Apply"
13. Answer "Pause and Reflect" on page 78 of the textbook.

Check your responses with your teacher or home instructor.

end of investigation

Using Science

All across Canada, studies are being done on ecosystems. Are they healthy? What makes them up? How are humans affecting them? One area being studied is in northern Alberta. The studies look at how development will affect the Northern River Basins region. A tremendous amount of data has been gathered. Now the data has to be interpreted and used to make decisions.

Turn to page 78 of the textbook and read "Using Science in Real Ecosystems." You will learn more about this example of science in action.

14. Give three reasons why the Northern River Basins Study was important.

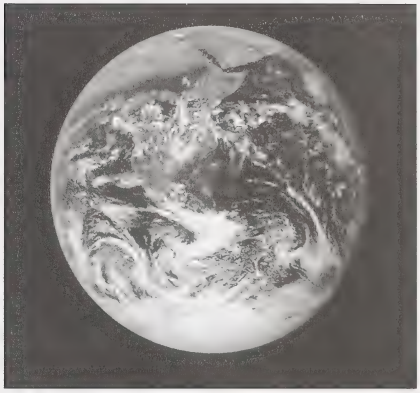
Compare your responses with the one in the Appendix, page 109.

You have now completed the new concepts for this lesson. Do the following questions to check your understanding.

15. Answer questions 1 and 3 of "Topic 7 Review" on page 78 of the textbook.

Compare your responses with those in the Appendix, page 109.

Looking Back



It's your world. You can choose to be knowledgeable and aware. Your daily choices influence the health of your local and global environments, as well as the choices of those around you.

Monitoring local and global environments are important! Ecosystem monitoring can be used to gather data. The data lets the impact people have be better understood and predicted. For example, long-term monitoring often looks at changes in specific indicator species.

In this lesson you analyzed indicator species data. You also conducted your own investigation. You collected baseline data about disturbed and undisturbed areas close to your home. The Northern River Basins Study served as a final example. It showed how concerned groups and individuals can use environmental impact assessments. They make informed, environmentally wise decisions possible.

Section 3 Review

Complete the following "Wrap-up: Topics 6–7" questions on page 79 of the textbook. They will help you review and apply the concepts and information in this section.

1. Answer questions 1 and 2 of "Reviewing Key Terms."

2. Answer questions 4, 5, 8, 9, 10, and 11 of "Understanding Key Concepts."

Check your responses with your teacher or home instructor.

Conclusion

Fire and water are familiar partners in ecosystem maintenance and change. You should now have a better understanding of how natural ecosystems change. These changes may be fast or slow; they may cause or start from complete desolation; or they may change through previously established ecosystems. You may have observed succession in your own investigation, finding that water can have a major impact on the organisms that can live in an ecosystem.

You have studied several examples of how humans influence changes in ecosystems. Not all of these changes have been negative. You found that some organisms were able to adapt to human-related change, others were not. Some changes to an ecosystem have been so great that an organism could no longer meet its basic needs. It either had to move or it died. Monitoring ecosystems helps people make responsible choices. They can see the choices that reduce the impact of their activities. With what you know now, could you, too, be an ecosystem partner?

Turn to pages 2 to 6 of Assignment Booklet 1C and answer questions 3 to 7.

Module Summary

In this module you identified ecosystems and learned how they functioned. Natural cycles move materials around. (You studied the water cycle and the carbon cycle for example.) Ecosystems respond to processes of change. The change can be natural or human-related. Environmental monitoring and research lets the results of human activity be tracked. Tracking is needed since some of the consequences are not intended. Unintended consequences mean responsible decision making and action to protect the environment is very important.

The national parks of Canada are ecosystems. Protecting their natural resources and natural processes is of the highest importance. But the parks are also to be enjoyed by people now and in the future.

There will be conflicts between wildlife and people. Four-lane highways will block the migration of elk, wolves, bears, and other wildlife. How do you ensure wildlife is not disturbed and provide road access for people? Environmental monitoring and research confirmed it. The answer—wildlife overpasses.

KARI GUNSON/TRANSCANADA HIGHWAY MONITORING PROJECT

Going Further

Well, the big one has finally arrived and it won't be a waste of time! Turn to pages 82 and 83 of the textbook. Follow the directions for "Unit 1: An Issue to Analyze." "Beyond the Curb: Is Recycling Really Reducing Garbage?" is an important question. It's being asked by concerned groups and individuals all over the world. This activity presents you with the opportunity to investigate, form an opinion, and perhaps even influence a real-life situation.

Review "Unit at a Glance" on page 84 of the textbook. It provides an excellent summary of the concepts from this module.

Answer the following "Unit 1 Review" questions on pages 84 to 87 of the textbook.

1. Answer questions 1, 2, 3, 6, 8, 9, 10, 11, and 14 of "Understanding Key Concepts."
2. Answer questions 17 and 21 of "Developing Skills."
3. Answer questions 25, 27, and 28 of "Problem Solving/Applying."
4. Answer questions 31, 32, and 37 of "Critical Thinking."

Check your responses with your teacher or home instructor.

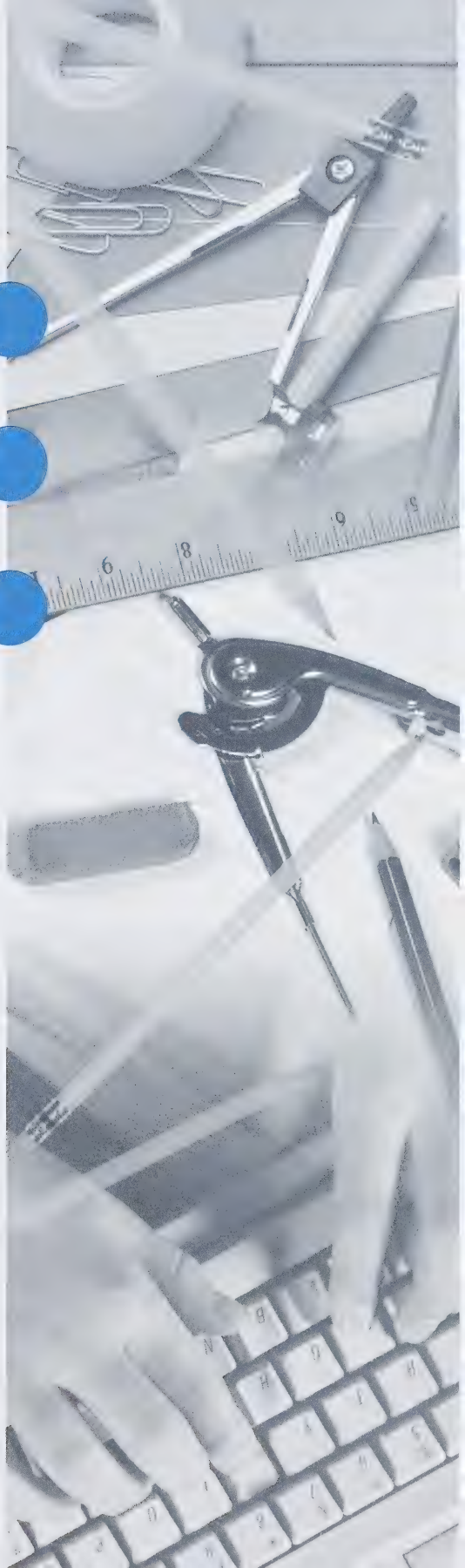
Turn to pages 7 to 12 of Assignment Booklet 1C and complete the Final Module Assignment.

Appendix

Glossary

Suggested Answers

Image Credits



Glossary

abiotic: having to do with non-living parts of an ecosystem

acid rain: rain (or snow, hail, fog) that is more acidic than normal

Acid rain forms when atmospheric water mixes with chemicals released by vehicles and industries, like sulfur and nitrogen oxides.

adaptation: an inherited structural or behavioural characteristic that increases a species's (or organism's) chance of surviving and reproducing in its environment

adapted: physically and structurally suited to one's niche (environment and lifestyle)

baseline data: data collected so it can be used for comparison to data gathered at a later time

behavioural adaptation: an inherited behavioural characteristic that increases a species's (or organism's) chance of surviving and reproducing in its environment

bioaccumulation: the buildup of pollutants in the bodies of organisms as the pollutants are passed through a food web

biological control: a method of using natural enemies, diseases, competitors, and so on to control pests

biomass: living or dead matter

biotic: of or relating to living (or dead) things

carbon cycle: the cycle in which carbon is used, released, and reused in an ecosystem

carnivore: an animal that only eats other animals

e.g., cougars, hawks, dragonflies

commensalism: a symbiotic relationship in which one partner benefits and the other neither benefits nor is harmed

community: populations of different, interdependent species interacting within a particular habitat

condensation: the process by which water vapour turns to liquid

consumer: an organism that eats other living things (or their products)

control: a sample that is treated the same as the experimental samples in every way except for the variable that is being manipulated

The control or control sample acts as a standard against which all experimental samples are compared.

controlled variable (CV): a variable that is not allowed to change (remains constant) throughout the course of an investigation

decomposers: microscopic (generally) organisms that break down dead or waste matter into nutrients

e.g., fungi, bacteria

ecological footprint: a calculation of the impact a person has on the natural environment

For example, scientists could determine the amount of land and water required to provide materials and energy as well as the associated wastes for an average Albertan.

ecology: the study of the relationships between organisms and their environment

ecologist: a scientist who studies the interactions of organisms and their environment

ecosystem: the interactions between living and non-living things in a particular environment

ecosystem monitoring: a system for checking the health of an ecosystem by collecting data and comparing these results with earlier observations

endangered species: a species that is likely to become extinct unless protective measures are initiated

energy flow: the transfer of energy from one organism (or food level) to another through the food chain or food web

Environmental Impact Assessment: a scientific report written to explain how a particular activity might affect or has affected an ecosystem

evaporation: the process by which liquid water turns to vapour

extinct: no longer living anywhere on Earth

extrapolate: to estimate an unmeasured value that goes beyond the known or measured data

fixed symbiosis: a close, long-term relationship between organisms of different species

food chain: energy (and nutrient) flow through a single series of organisms

Food chains always start with a producer.

food web: a network of feeding relations made up of interconnected food chains

ground water: water found beneath Earth's surface in the pores and cavities of rock and soil

habitat: the place or type of place where an organism lives

herbivore: an organism that eats only plant material (producers)

indicator species: an organism that is sensitive to changes to the ecosystem

interact: to act on or affect each other; to become physically or mentally involved with another organism or object

interpolate: to estimate an unmeasured value from within the range of known or measured data

introduced species: a species that did not naturally occur in an ecosystem

key: an arrangement of characteristics designed for the identification of unknown plants or animals

manipulated variable (MV): the variable that is purposely adjusted in an investigation to see what effect the change will have on the responding variable

mutualism: a symbiotic relationship in which both organisms benefit from the relationship

natural resources: materials from Earth that people need or use

niche: the role of an organism in an ecosystem

omnivore: an organism that eats both producers and consumers

e.g., grizzly bears, raccoons, humans

organism: a living thing

parasitism: a symbiotic relationship in which one of the organisms is harmed and the other benefits

permanent plot: an area that is used to collect data over an extended period of time

pH: a quantitative measure of the strength of an acid or base

The pH scale ranges from 0 to 14. On this scale, neutral substances have a pH of 7, acids have a pH less than 7 (0 being the strongest), and alkaline or basic substances have a pH greater than 7 (14 being the strongest).

pollutant: any substance that is harmful to the environment

pollution: the process in which harmful chemicals are released into the environment

population: a group of individuals of the same species living in a particular area

precipitation: the process by which water vapour from clouds is returned to the ground as rain and snow; the rain or snow itself that falls to Earth due to the process of precipitation

predator: a consumer that kills and eats other consumers

prey: consumers that are killed and eaten by other consumers

primary succession: ecosystem development in an area that has not been previously occupied

e.g., bare rock

producer: a green plant or other organism that can make its own food by photosynthesis

pyramid of biomass: a pyramid-shaped representation of the total mass of living (or dead) matter at each level of a food chain

pyramid of numbers: a pyramid-shaped representation of the number of organisms at each level of a food chain

qualitative: uses words (**l**etters and **l**anguage) to describe something

A qualitative description requires a comparison or reference point.

e.g., higher, colder, older, bigger

quantitative: uses **n**umbers to describe something

e.g., 12 years old, 24°C

recover: reclaim and use what was previously a waste material

recycle: a way of cutting down human impact on the environment by turning things normally thrown away into something else

reduce: cutting down the impact on the environment by cutting down the amount of garbage that is produced

respiration: the process by which organisms break down glucose (sugar) to produce energy

During this process, carbon dioxide and water are released as waste gases.

responding variable (RV): a variable in an experiment that is expected to change as a result of changes to the manipulated variable

reuse: cutting down human impact on the environment by reusing products rather than throwing them away

run-off: water that flows across the ground instead of soaking in or evaporating

scavengers: organisms that feed on dead organisms or wastes

e.g., earthworms, insects, magpies

secondary succession: ecosystem development in an area with soil after the previous community has been altered or destroyed

e.g., abandoned fields, forested areas, burned areas

species: a type of organism

Individuals within a species are very similar and normally reproduce only with each other.

species distribution: the pattern(s) in which organisms of one or more species live within a particular area

Species distribution is determined by the basic needs of the organisms.

structural adaptation: a specialized body part that helps an organism survive in its environment and lifestyle (niche)

succession: the process in which organisms new to an ecosystem become established, usually replacing organisms that were in the ecosystem

sustainable: of, relating to, or being a method of harvesting or using natural resources so the resources are being renewed at the same rate or faster than they are being used

In sustainable development, resources are neither used up nor permanently damaged.

sustainability: the quality of being sustainable

symbiosis: an interaction between organisms of different species living in close proximity to each other in a relationship that lasts over time

transpiration: the process by which plants give off water vapour to the atmosphere; evaporation of water from leaves via the stomata

variable: any factor that could change during the course of an investigation

water cycle: the world-wide circulation of water (powered by the Sun) between the atmosphere, surface water, and ground water

Suggested Answers

The answers in this Appendix are an important part of this Science course. Read them carefully when checking your work. They provide additional information, examples, and clarification. They also give you a quick way to see if your answer is right. It is a good idea to copy the things you learn into your notebook. What you learn from the suggested answers is often used later in the module or course. Refer to them as needed.

Section 1: Lesson 1

1. *Ecology* is the study of the relationships between organisms and their environment.

   An *ecologist* is a scientist who studies the interactions of organisms and their environment.

2. In the early 1900s, swift foxes were poisoned. It wasn't intentional. They were caught in a wolf and coyote control project. Also, the swift fox's habitat changed. People use the land for agriculture and other human development.

3. **Textbook question "Pause and Reflect," p. 7**

   Answers will vary. A sample answer is given.

   The animal chosen is a magpie. (You will be using your chosen animal throughout Module 1.)

4. Check your response with your teacher or home instructor.

5. a. The beaver is meeting its basic need for gaseous exchange. It is releasing carbon dioxide and obtaining oxygen.

   b. The plant wasn't able to meet its basic need for water.

   c. The coyote is meeting its basic need for shelter.

   d. The mosquito is meeting its basic need for food.

6. An *adaptation* is a modification of an organism or its parts. This change must make the organism more fit to live in its environment. The adaptation will be inherited by the organism's offspring.

   A structural adaptation is a specialized body part that helps an organism survive in its environment and lifestyle (niche). A behavioural adaptation is a specialized way an organism reacts to a change in its environment.

7. Obtaining food from "bear-proof" garbage cans is not an adaptation. It is merely survival. This behaviour was not inherited. Adaptations generally develop over many generations. They are not learned or taught by an individual. An exception to this general statement is a sudden genetic change. (This is known as a mutation.) It happens quickly, yet can be passed on to the young.

8. Discuss your creature with your teacher or home instructor.

9. Check your response with your teacher or home instructor.

10. to 12. Check your responses with your teacher or home instructor.

13. **Textbook question "Pause and Reflect," p. 16**

Answers will vary depending on the organism chosen. Sample answers are given.

The magpie (the host) has a parasitic relationship with mosquitoes (the parasite).

Some ants have a mutual relationship with aphids. The ants shelter the aphids in their hills during the winter. In the summer, they transport them to a feeding area and protect them. The ants drink the excess fluids the aphids have sucked out of plants.

Snails and hermit crabs have a commensal relationship. Hermit crabs receive the benefit of shelter from the shells of dead snails. The snails are unaffected by this.

14. **Textbook questions 1, 2, and 4 of "Topic 1 Review," p. 17**

1. a. The basic needs all organisms share are food, water, a suitable habitat, and gaseous exchange.

   b. **food:** Eat seeds, grasses, mushrooms, insects, and so on.

   water: Drink out of puddles, or drink the dew on grasses and plants.

   suitable habitat: Build a nest in a cavity in the ground or a grassy area near sources of food and water.

   gaseous exchange: Exchange gases with the atmosphere by breathing.

   A suitable habitat consists of appropriate shelter; adequate space; and where food, water, and shelter are reasonably available.

2. a. Webbing between its toes allows the duck to push harder against the water. It swims easier and faster.

   b. A falcon's long, sharp claws and strong toes are arranged for grasping (three in front, one behind). They let it grab its prey and fly away to a safe place where it can eat.

   c. Sketches will vary. They could show a duck paddling through the water or a falcon carrying its prey.

4. *Symbiosis* is the interaction between two different species that occurs over generations. The interaction can be positive or negative for either of the two species.

   Examples will vary. Examples in this module included shark/remora, rose/aphid, aphid/ant, tapeworm/person, and orchid/tree. Other examples include pet/owner (mutualism), cat/lice (parasitism), and ground squirrel/burrowing owl (commensalism).

Section 1: Lesson 2

1. **Textbook question 6 of "Topic 2 Review," p. 28**

   6. When the first settlers arrived in Alberta, they kept small farms where they were able to plant crops and raise livestock. These small farms allowed them to support themselves. Now, people depend on a variety of sources for food, clothing, and shelter. Items grown or produced in one area are shipped throughout the world. There are now large, urban populations and a "want"-oriented lifestyle. The environment is often overused, degraded, or destroyed to meet the wants and needs of humans.

2. The impact of large dams constructed by humans greatly exceeds the impact of small dams constructed by beavers (or humans). Study the following table. Note that the positive and negative effects of all dams are quite similar.

Impacts of Dams	
Positive Impact on Ecosystem	**Negative Impact on Ecosystem**
• Beaver dams provide food and shelter for the beaver. • New ponds and lakes (aquatic habitat) are created above the dam. • Tree removal for beaver dams create an open, grassy area. It can be used by a wide variety of organisms. • Hydroelectric dams provide electricity for homes. • Dams provide flood control. • Dams preserve water supply above themselves.	• The stream volume below dams decreases. This affects aquatic organisms and the animals that eat them. • Trees are removed around the water. Animals no longer have forest cover for protection. • Dams flood large areas above themselves. Farmland and natural habitats are destroyed. • Soluble mercury from the soil dissolves into stored water. • The water quality changes. • Fish migration patterns and other animal movements can be affected.

3. Check your responses with your teacher or home instructor.

4. All people have the same basic needs. The vast majority of North Americans live well beyond their needs. They spend a great deal of time focusing on their wants.

5. Two examples are as follows:

   - Large greenhouses have been built to grow fresh tomatoes. This conflicts with the need for habitat for migrating shorebirds.

   - Towns, campgrounds, and parking lots have been built in parks. This conflicts with the animals' need for prime wildlife habitat.

6. Check your responses with your teacher or home instructor.

7. and 8. Check your responses with your teacher or home instructor.

9. **Textbook questions 1 to 4 of "Analyze," p. 27**

   1. Wetlands are like a sponge because they gather, store, clean, and slowly release water to surrounding areas.

   2. When wetlands are paved over, their water control/cleansing function is lost. Water cannot be absorbed and, thus, drains off quickly, which may cause flooding in some areas and droughts in others. **Note:** The wetland habitat is destroyed and inhabitants must either move or die.

   3. Answers will vary. Two sample answers are given.

      - When the road was put in the middle of the wetland, the water could not travel from the top to the bottom of the pan. It built up along the road.

      - The sponges could not hold as much water as before. The sponge below the road remained dry.

   4. Answers will vary. Sample answers are given.

      A bridge over a narrow part of the wetland or a tunnel under the wetland might allow the developer to get across the wetland without disturbing it. A floating road could also be built. Perhaps culverts could be used to move the water and organisms under a road.

10. Check your responses with your teacher or home instructor.

Section 1: Lesson 3

1. In terms of natural resources, *sustainable* refers to a method of harvesting or using natural resources. You don't use them faster than they grow. That way there will always be about the same amount available.

   An *ecological footprint* is a calculation of the impact a person has on the natural environment. You figure out how much material, energy, and wastes are produced by one person. Then you find how much land and water is needed to provide them. This is the person's ecological footprint.

2. "North Americans do not live in a sustainable manner" means they are using natural resources and creating wastes at a faster rate than the Earth can produce and absorb them.

3. It would take two more planets the size of Earth (three altogether) to sustain a North American way of life for all people.

4. The smallest ecological footsteps are shown in the picture on the left in Figure 1.23 and in pictures A and B of Figure 1.24.

5. **Textbook questions a. to f. of "Instant Practice," p. 458**

   a. an armful of flowers (qualitative)
   12 carnations (quantitative)

   b. 40 L of gasoline (quantitative)
   a tankful of gas (qualitative)

   c. It took all afternoon to do the investigation. (qualitative)
   The investigation took 2 h and 45 min. (quantitative)

   d. It's so hot today. (qualitative)
   The temperature today is 32°C. (quantitative)

   e. The mass of the books is 5 kg. (quantitative)
   These books are really heavy. (qualitative)

   f. The park is 12 000 m^2. (quantitative)
   We have a large park near our school. (qualitative)

6. **Textbook question "Pause and Reflect," p. 31**

   Answers will vary. Sample reasons are given.

   - Cycle to school rather than being driven. Less energy is used and less pollution is created.
   - Take shorter showers so less water is used. It decreases the amount of sewage that must be treated and the amount of heat energy used.
   - Wear second-hand clothes. Because you're not buying new clothes, energy is not required to make, package, transport, store, and sell them. Also, less waste is produced, since the clothes are not being thrown out.
   - Live in an apartment or small house rather than a large house. Less energy is required for heat, and less land area is covered.

7. Check your answers with your teacher or home instructor.

8. Making sweaters out of pop bottles is an example of recycling.

9. Early settlers unintentionally destroyed the swift fox's habitat. They knew little about it and its ecosystem. They were busy trying to ensure that they and their families survived. The effect of more and more people doomed the swift fox. This wasn't realized until it was too late for the swift fox. Conflict between people and wildlife is usually settled in favour of people.

10. **Textbook question "Instant Practice," p. 476**

Comparing Nutrients in Various Food Types			
Type of Food	**Mass of Carbohydrates (g)**	**Mass of Protein (g)**	**Mass of Fat (g)**
125 mL (0.5 cups) cooked pasta	15	3	0
32 g of beef	0	7	5
half a banana	15	0	0
250 mL (1 cup) milk	12	8	3
1 large tomato	5	2	0

Note: If you were to be marked out of 10 marks for this table, the marking key may be as follows:

Specific title	1 mark
Using appropriate column arrangement	2 marks
Having the appropriate units	1 mark
Correct data placement	4 marks
Neatness	2 marks
TOTAL	10 marks

11. **Textbook questions 1 to 4 of "Topic 3 Review," p. 36**

1. Answers will vary. Some examples are given.

   - Bring a bag lunch to school rather than going out for lunch. This reduces your ecological footprint by choosing food that did not require as much energy to make.
   - Ride a skateboard or bike to a nearby location rather than getting a ride in a car. No pollution is produced and no non-renewable, natural resources are used.
   - Recycle cardboard and newspapers. This reduces the number of trees destroyed. It removes the energy costs of transporting and processing the paper. There is also less pollution from paper mills.

2. The three Rs are as follows:

   - **Reduce:** Cut down on the amount of packaging that is on the products you buy. Purchase items in bulk (if possible).
   - **Reuse:** Use products more than once, like reusable containers for sandwiches.
   - **Recycle:** Collect products you are finished using and turn them into something else.

3. Answers will vary. Survey questions might include the following:

   - Do you recycle? If so, what?
   - Do you use products made from recycled materials?
   - Do you reuse products? If so, what and how?
   - How do you get to work?

4. Most likely what you have in your lunch came from a store. Your great-great grandparents' lunch most likely came from their garden or farm. In fact, it is unlikely that they would have orange juice. Production, storage, and transportation of oranges and orange juice were very limited until the last few decades. Your great-great-grandparents' lunch definitely had a much lower impact on the environment. Less energy and natural resources were used making their lunches.

Section 1 Review

1. and 2. Check your responses with your teacher or home instructor.

Section 2: Lesson 1

1. *Interact* means to act on, affect each other, or to become physically or mentally involved with another organism or object.

   Biotic refers to the living (or once living) parts of an ecosystem.

   Abiotic refers to the non-living (never alive) parts of an ecosystem.

   A *niche* is the role an organism plays in its ecosystem.

   A *producer* is a green plant or other organism that can make its own food by photosynthesis.

   A *consumer* is an organism that eats other living things.

   A *herbivore* is an organism that only eats plant material (producers).

   A *carnivore* is an organism that only eats other animals.

   A *predator* is a consumer that kills and eats other consumers.

Prey are consumers that are killed and eaten by other consumers.

An *omnivore* is an organism that eats both producers and consumers.

2. **Textbook question "Pause and Reflect," p. 40**

Answers will vary. A sample answer is given.

A magpie is an omnivore that eats a wide variety of food. It is both a scavenger and a predator. It feeds on insects, seeds, road kill, bird eggs, chicks, garbage, and so on. It harasses competitors (such as squirrels, coyotes, and other birds) for food or space. As an aggressive, medium-sized bird, adults have little to fear from predators. Cats or predatory birds may attack young magpies. Magpies build large, stick nests in trees. A stick "roof" built over the nest offers protection from animals that might otherwise prey on their eggs or young.

3. and 4. Check your responses with your teacher or home instructor.

5. a. **Textbook questions a. to d. of "What to Do," p. 41**

a. Approximately 20 000 lynxes were harvested by trappers in 1845.

b. In 1845, about 80 000 hares were harvested by trappers (four times more than lynxes).

c. In 1855, about 25 000 lynxes and 20 000 hares were harvested.

d. In 1865, about 75 000 lynxes were harvested and 160 000 hares were harvested. This might have happened because previous populations of both species were fairly low. Low populations would allow the hares' food supply to increase. More food would allow more hares. This would be followed by the lynx population increasing. The plants that the hares eat do not appear on this graph.

b. **Textbook questions 1 and 2 of "Analyze," p. 41**

1. The lynx population appears to peak slightly after the hare population. It also crashes slightly after the hare population crashes.

2. Prey controls a predator's population. When there are lots of prey, the predator population increases. They have a lot of food. When there are few prey, the predator population decreases. There is not enough food.

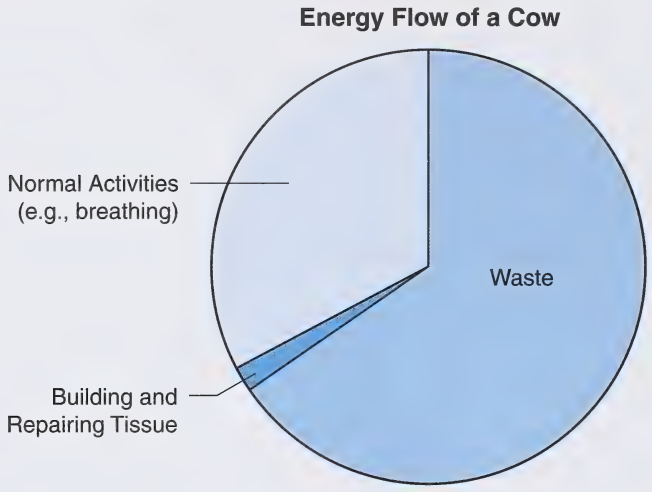
   Predators control a prey population. When there are lots of predators, the number of prey eaten increases. This decreases the population of prey.

6. A *food chain* is the energy (and nutrient) flow through a single series of organisms. Food chains always start with a producer.

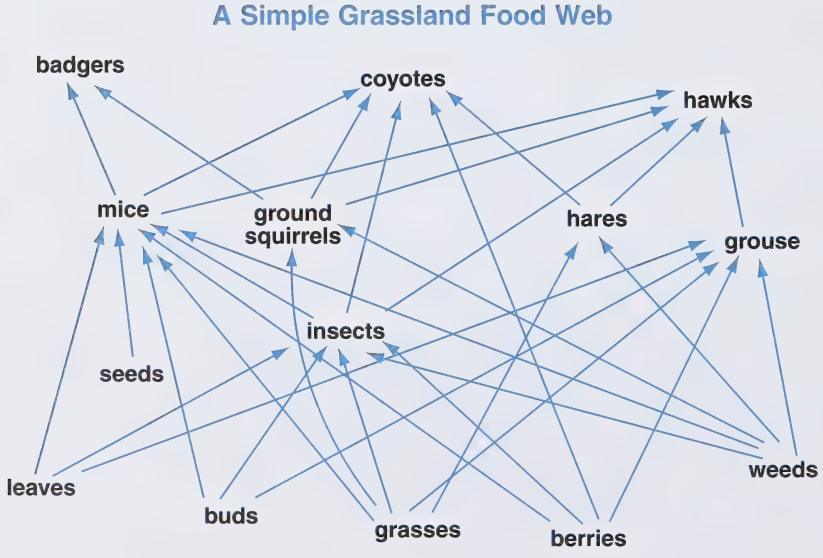
Energy flow is the transfer of energy from one organism (or food level) to another through the food chain or food web.

7. At each step in a food chain, energy is used by the organism. The organism uses energy to grow, digest, move, keep warm, reproduce, breathe, and so on. Food energy is also lost as waste in feces and urine. Imagine what you would look like today if your body had stored every single bite of food you have eaten since you were born. It is obvious that the vast majority of the energy from the food you eat is used or lost as you live your life. Suppose you fell into the ocean and a killer whale swallowed your body. Would that whale get the energy from every single chocolate bar, peanut butter sandwich, and teething cookie you ever ate? Of course not, because you already used or wasted that energy. The only nutrients and energy the whale can get from you is what's stored in your body the day you were swallowed.

8. Answers will vary. A sample circle graph is given.



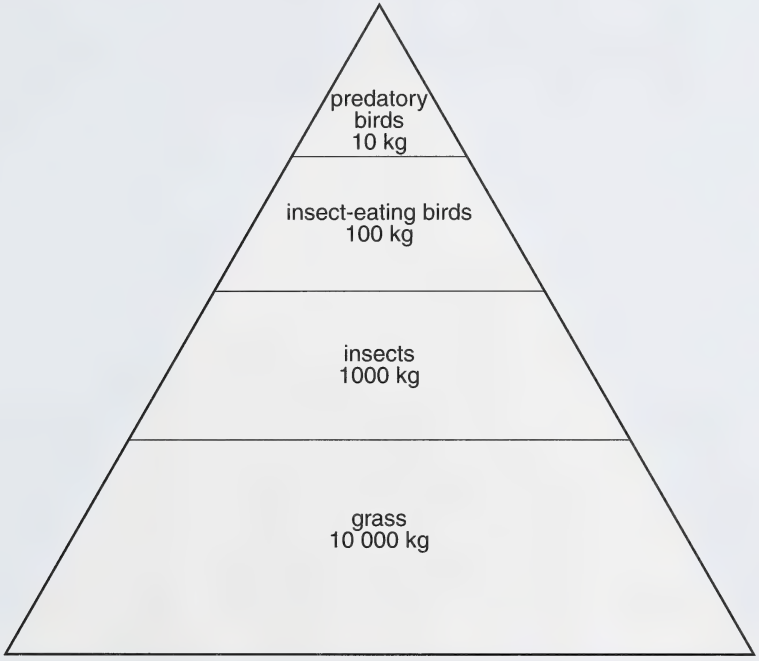
9. Food webs will vary. A sample web is given.



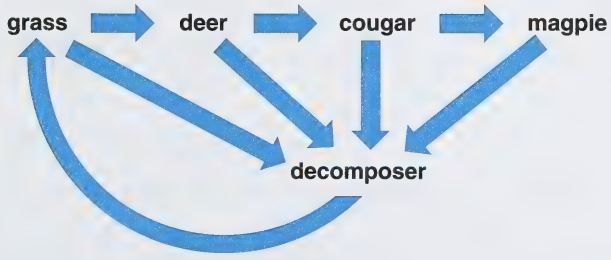
10. A *pyramid of numbers* is a pyramid-shaped representation of the number of organisms at each level of a food chain.

    A *pyramid of biomass* is a pyramid-shaped representation of the total amount of living (or once-living) matter at each level of a food chain.

11. Your pyramid of biomass should look something like this.



12. Decomposers fit into every step in the food chain or food web. They break down all the wastes and body parts that are not eaten by other consumers.



13. **Textbook questions 1 to 4 of "Topic 4 Review," p. 48**

1. Answers will vary. Sample answers are given.

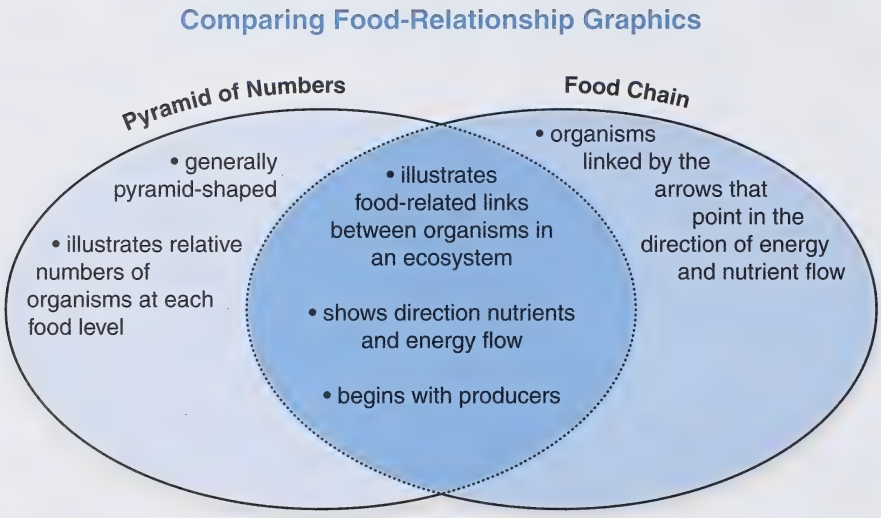
   a. A *producer* is an organism that makes its own food. Grass is an example of a producer.

   b. An *omnivore* is an organism that eats plant and animal matter. A swift fox is an example of an omnivore.

   c. A *predator* is an animal that hunts other animals for food. A wolf is an example of a predator.

   d. A *decomposer* is an organism that breaks down dead or waste material into nutrients. Fungus is an example of a decomposer.

2. Answers will vary. A sample Venn diagram is given.


Comparing Food-Relationship Graphics
Pyramid of Numbers
• generally pyramid-shaped
• illustrates relative numbers of organisms at each food level
Food Chain
• organisms linked by the arrows that point in the direction of energy and nutrient flow
• illustrates food-related links between organisms in an ecosystem
• shows direction nutrients and energy flow
• begins with producers

3. Energy is used or lost at every step in a food chain. Some energy is lost as heat and waste. The rest of the energy is mostly used for life processes, like breathing, growing, and moving.

4. Answers will vary. Sample food chains are given.

grass → mouse → snake → hawk

grass → ground squirrel → hawk

algae → water beetle → salamander → coyote

Section 2: Lesson 2

1. The *carbon cycle* is the cycle in which carbon is used, released, and reused in an ecosystem.

   The term *pH* is a quantitative measure of how strong an acid or base is. The pH scale ranges from 0 to 14. On this scale, acids have a pH of less than 7 (0 being the strongest). Neutral substances have a pH of 7. Alkaline or basic substances have a pH greater than 7 (14 being the strongest).

2. Plants use the carbon dioxide in the air to make food through photosynthesis. It is an essential building block for the bodies of all organisms. Carbon is stored in the bodies of organisms. (It is returned to the air as organisms breathe or pass through the food chain until it is returned to the soil by decomposers.)

3. Check your response with your teacher or home instructor.

4. to 6. Check your responses with your teacher or home instructor.

7. The *water cycle* is the world-wide circulation of water (powered by the Sun) between the atmosphere, surface water, and ground water.

   Evaporation is the process by which liquid water turns to water vapour.

   Transpiration is the process by which plants give off water vapour to the atmosphere (evaporation of water from leaves via the stomata or pores).

   Condensation is the process by which water vapour turns into liquid water.

   Precipitation is the process by which water vapour from clouds is returned to the ground as rain or snow. The term *precipitation* also refers to the rain or snow itself that falls to Earth.

   Ground water is water found beneath Earth's surface in the pores and cavities of rock and soil.

   Run-off is water that flows across the ground instead of soaking in or evaporating.

8. You should have observed that condensation formed on the plastic wrap covering the bowl. When the droplets get big enough, they fall off the plastic wrap and back into the bowl. The condensation process speeds up as the temperature decreases.

9. The water droplets collecting on the plastic demonstrate condensation. The water droplets falling back into the bowl demonstrate precipitation. The gaseous water that condenses (turns into water droplets) on the plastic wrap demonstrates evaporation.

10. *Pollution* is the occurrence of harmful substances that have been released into the environment.

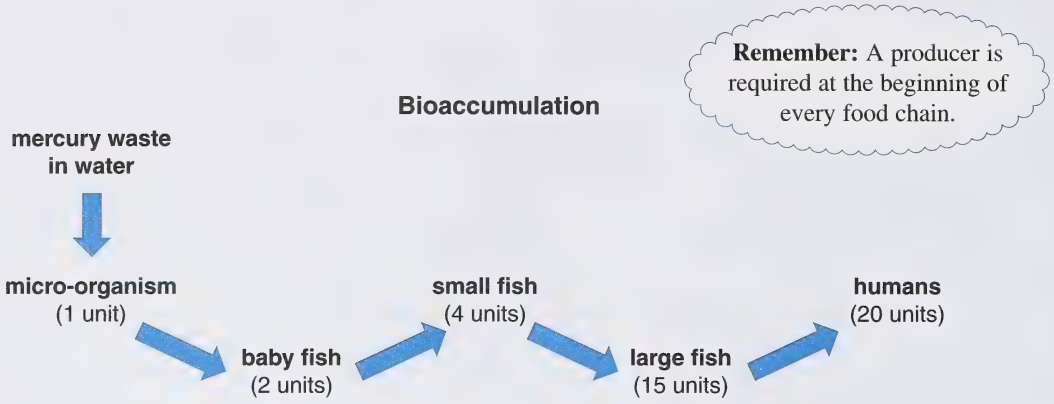
    A *pollutant* is any substance that is harmful to the environment. It is any substance that causes pollution.

    Acid rain is precipitation (rain, snow, hail, or fog) that is more acidic than normal. It occurs when atmospheric water mixes with chemicals (sulfur and nitrogen oxides) released by vehicles and industries.

11. Examples of pollutants that move through the environment include carbon dioxide (if present in high concentrations), sulfur, nitrogen, PCBs, mercury, and DDT.

12. *Bioaccumulation* is the buildup of toxins (poisons) in the bodies of organisms as stable, non-excretable pollutants are passed up a food chain.

13. The mercury waste in the water is taken in by photosynthesizing micro-organisms.


Remember: A producer is required at the beginning of every food chain.
Bioaccumulation
mercury waste in water
micro-organism (1 unit)
baby fish (2 units)
small fish (4 units)
large fish (15 units)
humans (20 units)

14. **Textbook question "Pause and Reflect," p. 54**

    Blue whales would be at the top of the pyramid of biomass. They would have to eat a tremendous amount of tiny plankton to survive. The total biomass of the plankton would have to be at least 10 times greater than that of the whale.

15. **Textbook questions 1 to 5 of "Topic 5 Review," p. 54**

    1. Increased carbon dioxide emissions could upset the balance. They might come from forest fires or the burning of fossil fuels. Removing or adding large numbers of plants could also upset the balance. Plants remove carbon dioxide from the air.

    2. Pesticides used on insects can move up the food chain. Birds eat the insects. The stable, non-excretable pesticides accumulate in the birds' bodies. The predators or scavengers that eat the birds get a larger dose. The further up the food chain the chemical goes, the more concentrated it becomes.

    3. Your diagrams should be similar to the one already in your notebook. Include brief explanations of evaporation, precipitation, condensation, and transpiration.

    4. Cutting down trees and burning forests can increase the level of carbon dioxide in several ways:

        - Trees take in carbon dioxide and produce oxygen through photosynthesis. Cutting down or burning trees means that there are fewer trees. Less photosynthesis takes place. So the amount of carbon dioxide removed from the air decreases.

        - Burning trees releases stored carbon in the form of carbon dioxide.

    5. The environment has reused many of its components (water, carbon, minerals, oxygen, nutrients) over and over again for millions of years.

Section 2 Review

1. and 2. Check your responses with your teacher or home instructor.

Section 3: Lesson 1

1. *Succession* is the process in which organisms new to an ecosystem replace organisms that were in the ecosystem.

   Primary succession is the development of an ecosystem in an area, like bare rock, that has not been previously occupied.

   Secondary succession is the development of an ecosystem in an area with soil where the previous community has been altered or destroyed. For example, abandoned fields, forested areas, and burned areas.

2. The heat of a forest fire is required to open jack pine and black spruce cones and release their seeds. After the seeds are released, they will germinate and grow, rejuvenating the forest.

3. The ecosystem developing in Figure 1.48B is a forest ecosystem that has been burned. New plants, like fireweed (the purple flower), are moving into the area through the process of secondary succession.

   The photograph on page 59 provides an example of primary succession. Plants are beginning to grow in a previously barren area.

4. No. The cumulative effects of human activities often create unpredicted environmental changes. How much change would a single, newly cleared field cause? How about a few acres cut down? or a single pond? or natural area turned into a shopping complex? One activity may have a relatively small effect on the larger environment. However, add these seemingly small changes together and the consequences become staggering. Scientific study of the vireos and brown-headed cowbirds in their natural environment might have made the sequence of events predictable. Human needs and wants might still have made it inevitable.

5. Coyotes are far more adaptable to the presence of humans than wolves. Humans have caused the extinction of wolves from much of their natural range. The coyote is a scavenger, an omnivore, and a small-animal predator. It has a tolerance for the presence of humans. The wolf is a large-animal predator. The coyote's niche lets it succeed, whereas the wolf's niche does not.

6. *Biological control* is a method of using natural enemies, diseases, competitors, techniques, and so on to control pests.

7. The downsides to using pesticides include the following:

   - Other, beneficial organisms, including natural predators and competitors of the insect pests, are also killed or harmed.
   - Pesticides can bioaccumulate. They can harm or kill organisms higher in the food chain.
   - Pest species can develop a resistance to the pesticide. Over time, more pesticide is needed.

8. An *introduced species* is a species that did not naturally occur in an ecosystem.

9. Species that have been introduced to Alberta include apples and corn.

10. Purple loosestrife has escaped from flower gardens in Alberta and is now growing wild throughout most of the area in which it was introduced.

11. Habitat loss and introduced species are two main reasons for species extinctions.

12. Landowners help by protecting the burrowing owl's habitat and by avoiding the use of chemicals near their burrows.

13. Check your responses with your teacher or home instructor.

Section 3: Lesson 2

1. a. *Ecosystem (environmental) monitoring* is a system for checking the health of an ecosystem. It includes collecting data and comparing these results with observations taken at other times.

   b. The four basic categories of ecosystem monitoring are

   - physical (using satellites to track landscape changes over time)
   - environmental (tracking changes in climate, temperature, and weather patterns)
   - chemical (assesses air, soil, and water quality)
   - biological (tracking changes in organisms or populations)

2. An *indicator species* is an organism that is sensitive to changes in an ecosystem. Frogs, toads, and canaries are examples of indicator species.

3. Natural disasters can be very useful to scientists because they can monitor the development of an ecosystem from the very beginning.

4. Amphibians have very thin skin that is not protected by hair, scales, or slime. They absorb much of their oxygen supply through their skin. Their eggs and young spend all the time in the water. They eat food from the water. Adults spend the vast majority of their lives in or around the water. They also eat many aquatic organisms. Amphibians are very vulnerable to toxic chemicals in their habitat. They will likely react to pollutants long before they are detected in other ways. They may die, have a decrease in reproductive success, have more mutations, or show a declining population.

5. and 6. Check your responses with your teacher or home instructor.

7. Check your response with your teacher or home instructor.

8. Using the dichotomous key, the best matches for each are as follows:

   Tree A: 1(a), 2(a), aspen

   Tree B: 1(b), 3(a), 4(b), 5(b), black spruce

9. Going into a treed area to examine the trees and working with branches would have made the activity easier. Photographs with more detail would make this activity easier as well.

10. *Baseline data* is information that is collected so it can be used for comparison to data gathered at a later time.

    A *permanent plot* is an area used to collect data over an extended period of time.

    An *Environmental Impact Assessment* is a scientific report written to explain how a particular activity might affect or has affected an ecosystem.

11. It is important to collect baseline data because it acts as a starting point (a standard) for comparison with data collected at a later time. Baseline data makes it possible to find and verify (prove) changes in the ecosystem.

12. and 13. Check your responses with your teacher or home instructor.

14. The Northern River Basins Study was important because

    - the lifestyle of the Aboriginal people was being threatened by the economic development in the area
    - industries were affecting the health of the ecosystem
    - it helped scientists assess (judge, quantify, categorize) and understand the impacts on the biotic and abiotic components in the ecosystem
    - it helped scientists make recommendations of ways to reduce the human impact in the area

15. **Textbook questions 1 and 3 of "Topic 7 Review," p. 78**

    1. Long-term monitoring is used to protect natural ecosystems by allowing scientists to recognize dangerous changes. Scientists can come up with solutions to overcome these changes.

    3. There are many volunteer monitoring programs that Canadians can be involved in. They include the Christmas Bird Count, backyard bird feeder studies, the Canadian Wildlife Federation's moth and butterfly survey or ladybird beetle survey, and amphibian surveys.

Section 3 Review

1. and 2. Check your answers with your teacher or home instructor.

Module Summary

1. to 4. Check your responses with your teacher or home instructor.

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